Chronica Botanica

Agronomia — Biologia — Genetica

Chronica Botanica

An International Collection of Studies *in* THE METHOD *and* HISTORY *of* BIOLOGY *and* AGRICULTURE

edited by FRANS VERDOORN, PH. D.

Managing Editor of 'A New Series of Plant Science Books' and 'Annales Cryptogamici et Phytopathologici'; Assoc. Editor, 'Natuurwet. Tijdschr. voor Ned.-Indië', 'Rec. Trav. Bot. Néerl.', 'Farlowia', 'Bryologist'; Bibliographer, Arnold Arboretum of Harvard University; Botan. Adviser, Board for the Netherlands Indies; Hon. Sec., Bot. Section of the Int. Union of Biological Sciences; Hon. Sec., Committee for Hepaticae of the Int. Nomenclature Commission; etc.

A link between plant scientists in all branches and in all countries

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Phytopathologia – Silvicultura – Horticultura

NOW THAT WE ARE AGAIN CONSIDERING

THE RESUMPTION AND POSSIBILITIES

OF COOPERATIVE CONSTRUCTIVE ACTIVITIES

AND

INTERNATIONAL RELATIONS

IN BIOLOGY AND AGRICULTURE

IT SEEMS FITTING

TO DEDICATE THIS

THE TENTH VOLUME

OF

CHRONICA BOTANICA

TO

JAN PAULUS LOTSY

WHO DID MORE

THAN ANYONE OF US TODAY

FOR THE PROMOTION OF

INTERNATIONAL RELATIONS IN OUR FIELD

Que j'aime à contempler, ô Nature infinie!
Tes merveilleux secrets, ta sublime harmonie.
Moi, faible atome humain, qu'anime un court instant
Ton soufle créateur, éternel, tout-puissant.

Heureux qui te comprend, source féconde, immense,
Des plaisirs les plus purs de ma pauvre existence,
Spectacle ravissant pour qui sait t'admirer,
A toi tous mes loisirs que toi seul peux charmer.

C'est au sein de tes dons qu'il est doux de s'instruire,
Là, l'oeil observateur à chaque instant peut lire,
Cet inflexible arrêt sur chaque objet écrit:
Tout se transforme et meurt, rien ne s'anéantit.

Cette immuable loi, à chaque pas présente,
Règle aussi bien les Cieux que la plus humble plante,
L'astre et le végétal, aux mêmes lois soumis,
Offrent également des secrets infinis.

Etudiez, amis, car c'est dans la science,
Qu'avec rapidité s'accroît l'intelligence,
Qu'un homme vraiment fier et digne de ce nom,
Assied son jugement, éclaire sa raison.

En premier lieu plaçons la chère Botanique,
Douée éminemment d'un attrait sympathique,
A tout esprit chercheur, vrai amateur du beau,
Offrant sans cesse aux yeux quelque charme nouveau.

O vous! heureux amis de l'éternelle Flore!
Botanistes zélés, qu'un feu sacré dévore,
Revêtez votre armure et voyagez gaîment,
Car voici de nouveau le retour du printemps.

C'est pour guider vos pas dans nos riches parages,
Que ma plume inhabile écrit ces quelques pages,
Bienheureux si je puis charmer quelques loisirs,
D'un enfant Beaujolais, ami des vrais plaisirs.

Explorez avec soin ces beaux coteaux calcaires,
Et les bois ombragés, les bords de nos rivières,
Cueillez soigneusement de beaux échantillons,
Surtout conservez-en fidèlement les noms.

Et quand viendra l'hiver et ses jours de tristesse,
Visitez votre herbier, augmentez sa richesse,
Montrez-le aux amis, inculquez-leur vos goûts,
Et le printemps suivant ils seront avec vous.

Révil et Dérresse

• Chronica Botanica, Volume 10, Number 1 •

ESQUISSE
de mes
VOYAGES
au
BRÉSIL
et
PARAGUAY

FIGURE 1. — AUGUSTE DE SAINT-HILAIRE (1779-1853)

Drawing by M. MEDINA (reproduced, with kind permission of the editors, from the Revista Brasileira de Geografia, Vol. 2, opp. p. 245, 1940).

ESQUISSE
DE MES
VOYAGES
AU
BRÉSIL ET PARAGUAY

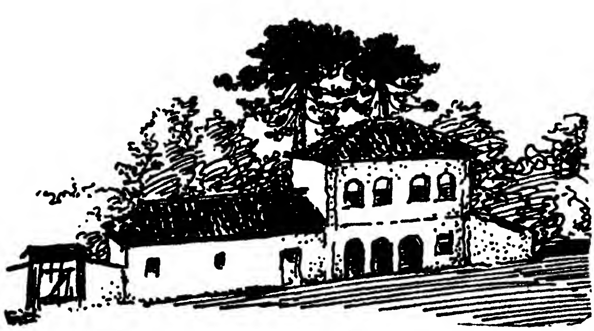
considérés principalement sous le rapport de la botanique

BY

AUGUSTE DE SAINT-HILAIRE

with an introductory essay by

ANNA E. JENKINS, Ph.D.
Mycologist, United States Department of Agriculture



CONTENTS

The following biographical sketch of AUGUSTIN FRANÇOIS CÉSAR PROUVENSAL DE SAINT-HILAIRE, called AUGUSTE DE SAINT-HILAIRE, is quoted from the Proceedings of the Linnean Society (London) (2: 323-325, 1854); the author was probably the secretary of the Society at that time, namely, JOHN JOSEPH BENNETT:

AUGUSTE DE SAINT-HILAIRE, was born at Orléans in the year 1779. At an early age he evinced a predilection for the study of natural history, and when scarcely seventeen attached himself with ardour to entomology. His inclinations were, however, thwarted for a time by the necessity of making a journey into Holstein; but while there, the acquisition of the German and English languages greatly enlarged his means of obtaining scientific information. On his return after a few years to France, he again applied himself to entomology, but soon quitted it for botany, to which he devoted the remainder of his life. He had been offered the post of Auditor of the Council of State, and many motives combined to induce him to accept this appointment; but after a fortnight's consideration he resolved to refuse it, as incompatible with his favourite pursuit. Living at a distance from any large collections, having no teacher, and but few books, his observations were at first limited to the plants of his immediate neighbourhood, which he submitted to a rigorous examination. His earlier contributions to science were published in the "Bulletin de la Société des Sciences Physiques, etc. d'Orléans," in DESVAUX's "Journal de Botanique," and in the "Bulletin de la Société Philomatique." He next entered on the preparation of an "Histoire complète des Pistils et des Fruits des Plantes de la France," for which he collected extensive materials, but finding that its completion would require many years of travel and observation, he determined to extract from it a series of memoirs calculated to throw light on some of the more important points of vegetable physiology. With this view he published in the "Annales," and in the "Mémoires du Muséum d'Histoire Naturelle de Paris," several valuable memoirs, the most remarkable being the first of a series "Sur les Plantes auxquelles on attribue un placenta central libre," which at once placed him in the rank of the more scientific and philosophical botanists of the day. About this time an opportunity offered itself of observing the vegetation of a warmer country, and he eagerly embraced the permission given him by the Duke of Luxemburg, who was appointed ambassador at Rio, to accompany him to Brazil, in the southern provinces of which empire, in the Cisplatine province, and in Paraguay, he travelled during the six years from 1816 to 1822. His various journeys reached an extent of 2500 French leagues, and his collection amounted to about 7000 species of plants, of most of which he made analyses on the spot, 2000 birds, 16,000 insects, and 129 quadrupeds, besides reptiles and other animals. While in Brazil he continued his communications to the "Mémoires du Muséum d'Histoire Naturelle"; and immediately after his return he set about the publication of the results of his travels in the various departments of botanical science. These were chiefly given in an "Aperçu d'un Voyage dans l'Intérieur du Brésil" [Mém. Mus. Hist. Nat. 9:307-380, 1822], in the "Mémoires du Muséum"; in his "Histoire des Plantes les plus remarquables du Brésil et du Paraguay", 4to, Paris, 1824; in his "Plantes usuelles des Brésiliens," 4to, Paris, 1824-8; in the "Flora Brasiliae Meridionalis," of which 24 fasciculi, forming 2 vols. and a part of a third, were published by him with the assistance of ADRIEN DE JUSSIEU, CAMBESSÈDES and other botanists, between 1825 and 1833 [Paris, 1825 — 1833]; in his "Voyage dans le Province de Rio Janeiro et de Minas Geraes," Paris, 1830, 2 vols., 8vo; and in his "Voyage dans le district des Diamans et sur le litoral du Brésil," 2 vols., 8vo, Paris,

1833. His health in the mean time became greatly deteriorated by his labours, both in the cabinet and in the field; he fell into an extreme state of nervous debility, lost the faculty of speech, and in a great degree of sight also; and was compelled to retire to Montpellier, where the pure air, and the care of his friendly physicians, DUNAL and LALLEMAND, at length restored him in a great measure to his former activity. He resumed his contributions to the "Mémoires du Muséum," and published in 1840, in 8vo, his last great work, under the title of "Leçons de Botanique, comprenant principalement la Morphologie végétale, la Terminologie, la Botanique comparée, et l'Examen de la Valeur des Caractères dans les diverses Familles naturelles." [939 p., 24 pl., Paris, 1840]. In this work he has given a resumé of the philosophical ideas which formed through life the groundwork of his botanical investigations, and which fixed the stamp of originality on his views, while the accuracy of his observations gave a high value to his systematic labours. He was elected a Correspondent of the Academy of Science during his absence in Brazil, and in 1830 succeeded LAMARCK as a Member of the Botanical Section. His election into the Linnean Society dates from 1827, and he died on the 3rd day of May (*sic*) [September 30, see p. 11], 1853.

Additional as well as more intimate history relative to SAINT-HILAIRE is contained in the biographical notice of the botanist, traveller, and teacher, by his devoted student PLANCHON (Rev. Hort., 1854; 176-180). It is a pleasure also to quote in full this biographical sketch of the savant:

Notice sur Auguste de Saint-Hilaire.

Les deuils se succèdent pour la botanique avec une désolante rapidité. Sans parler des pertes si nombreuses de l'Allemagne, hier à peine s'éteignaient en France les dignes héritiers de noms illustres, RICHARD et JUSSIEU. Aujourd'hui le représentant le plus direct, le doyen vénéré de l'école que rappellent ces deux noms, AUGUSTE DE SAINT-HILAIRE, vient de succomber à de longues et cruelles souffrances.

Éloigné par caractère de toute recherche de popularité, l'auteur de la *Morphologie végétale*, au double titre de botaniste et de voyageur, n'en occupait pas moins une place éminente dans l'opinion du public scientifique. Il laisse, comme homme privé dans les cœurs de nombreux amis, comme maître dans le souvenir de ses élèves, des traces profondes de regrets et d'affection. La souffrance et l'amitié prirent une si large part de sa vie! Le cœur chez lui tenait de si près à l'intelligence! Il partageait lui-même si vivement l'influence sympathique qu'il exerçait sur la jeunesse studieuse! Mais cette part intime de son caractère appartient au culte privé des affections; une autre part, celle du savant, reste assez brillante pour mériter plus que la rapide esquisse à laquelle nous sommes forcé de la restreindre.

AUGUSTE DE SAINT-HILAIRE naquit en 1779, à Orléans, dans une famille riche et honorée. Des motifs d'attachement lui firent passer les premières années de sa jeunesse auprès d'un oncle maternel que l'orage révolutionnaire avait contraint de chercher un refuge à Hambourg. La fortune de sa famille ayant souffert des troubles du temps, il essaya d'utiliser son activité dans la carrière du commerce, et, bien que la routine du *doit* et *avoir* fût évidemment peu sympathique aux goûts du futur membre de l'Institut, peut-être servit-elle à confirmer en son esprit ces habitudes d'ordre, de méthode et de minutieuse exactitude, empreintes dans ses œuvres comme dans sa vie. Il gagna, du reste, à ce séjour dans le Nord, la connaissance de l'allemand, ressource comme providentiellement acquise au futur interprète des idées philosophiques de GOETHE sur la morphologie des plantes.

Rentré dans sa famille vers les premières années du siècle, l'excellent livre de DUBOIS sur les plantes des environs d'Orléans lui révéla sa vocation. Alors commencent pour lui cette riante lune de miel de l'initiation scientifique, cette joyeuse course au clocher dans le champ encore vierge de l'observation, ces plaisirs naïfs et purs de l'histoire naturelle en plein air, dont le souvenir revient souvent, comme un rayon de jeunesse, animer les graves méditations du savant. Il partageait ces plaisirs avec deux amis, DUTOUR DE SALVERT, son beau-frère, dont il ne râppelait jamais qu'avec attendrissement les brillantes et solides qualités, et M. PELLETIER, d'Orléans, un de ces savants que l'obscurité de la province prive des faveurs de la renommée, sans leur ôter, heureusement, ni le goût ni les douceurs de la science.

La méthode dite dichotomique, pour arriver au nom des plantes, est, dans l'application, un excellent moyen d'étude des organes. Heureusement pour SAINT-HILAIRE et ses amis, c'était la marche de leur livre, et ce que DUBOIS taisait ou disait à demi-mot, leur intelligence savait le découvrir dans la nature.

Quelques années se passèrent dans ces fortes et fécondes études; mais bientôt les nécessités de la vie séparèrent les trois amis. Encore incertain sur le choix d'une carrière, SAINT-HILAIRE arrive à Paris. Il y voit LAURENT DE JUSSIEU, LOUIS-CLAUDE RICHARD, DESFONTAINES; c'est dire qu'il a trouvé ses maîtres et que sa destinée est fixée.

Résoudre sous l'inspiration de JUSSIEU les problèmes d'affinité; pénétrer sous l'œil de RICHARD les secrets de l'organisation; s'exercer, avec les conseils du bon DESFONTAINES, à la connaissance et à la description des espèces, telle est la triple direction dans laquelle s'élance le jeune adepte, excité par une émulation généreuse avec son intime ami KUNTH[1], qui s'occupait alors de décrire les collections botaniques des illustres voyageurs HUMBOLDT et BONPLAND. De savants mémoires admis dans le recueil officiel du Muséum marquent le mérite de SAINT-HILAIRE dans la première période de sa vie scientifique. Suivons-le maintenant sur un théâtre plus vaste et plus neuf, dans ce long tête-à-tête avec la nature tropicale, où son esprit observateur devait puiser tant d'éléments pour les travaux de la seconde partie de sa carrière.

En 1816, le Brésil est librement ouvert à l'Europe. AUGUSTE DE SAINT-HILAIRE obtient une mission officielle comme voyageur, et s'embarque avec l'ambassade française pour cet Eldorado des sciences naturelles. Six années d'excursions le conduisirent successivement dans les provinces de Rio de Janeiro, d'Espiritu-Santo, de Minas-Geraes, de Matto-Grosso, de Saint-Paul, de Sainte Catherine, de Rio-Grande, et dans les anciennes missions du Paraguay, étendue immense et d'une richesse de végétation en rapport avec la variété de ses climats. Un journal d'observation, tenu jour par jour avec une merveilleuse ponctualité, des collections immenses en zoologie et en botanique, la découverte des sources du Rio San-Francisco, mille autres documents précieux sur la géographie, l'histoire, la statistique, l'administration, l'ethnographie de ces régions, et sur les mœurs des habitants indigènes ou colons, furent le fruit de cette magnifique exploration, pendant laquelle l'auteur reçut, sans l'avoir sollicité, le titre de correspondant de l'Institut, titre littéralement mérité, puisque SAINT-HILAIRE, au milieu des fatigues du voyage, trouvait moyen de rédiger des mémoires pour l'Académie des Sciences.

De retour en France vers 1823, AUGUSTE DE SAINT-HILAIRE, au lieu d'y chercher le repos, se lance plus avant dans le tourbillon de la vie active. Dès 1824 il publie simultanément deux de ses œuvres importantes, les *Plantes les plus remarquables du Brésil et du Paraguay*, et les *Plantes usuelles des Brasiliens*. En 1825 il commence à faire paraître son *Flora Brasiliæ meridionalis*, œuvre capitale, pour laquelle il s'adjoignit plus tard (comme pour les *Plantes usuelles*) la collaboration de CAMBESSÈDES et d'ADRIEN DE JUSSIEU. Restés incomplets par rapport à leur plan primitif, ces ouvrages n'en sont pas moins des modèles dans le genre, et suffiraient amplement à la gloire scientifique de leur auteur.

Déjà pourtant la première crise d'une terrible maladie nerveuse avait ouvert cette douloureuse lutte entre la souffrance et l'activité dans laquelle s'est usée une si précieuse existence. A trois reprises et durant des années entières, SAINT-HILAIRE n'a vécu que pour souffrir; mais dans les intervalles il a vécu tout entier à la science. Correspondance immense, mémoires et rapports scientifiques, enseignement officiel, tout, sans parler de ses ouvrages de longue haleine, atteste la fécondité de son esprit et l'heureuse facilité d'une rédaction élégante, sans recherche, claire surtout, et d'une pureté que peu de savants ont égalée.[2]

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[1] It was during this period that KUNTH named a genus of grasses in SAINT-HILAIRE's honor, *viz*. *Hilaria* HBK (Nov. gen. et Sp. 1: 116, 1815).—*Note by* A. E. JENKINS.

[2] During this period and just before his "Morphologie Végétale" (1840) was published, we find that, among SAINT-HILAIRE's undertakings, was his editorship (1837-1839) with J. C. A. BUREAU of "Annales des Voyages de la Géographie, de l'Histoire et de l'Archéologie . . ."—*Note by* A. E. JENKINS.

Membre résident de l'Institut depuis 1830, en remplacement DE LAMARCK, il fut nommé peu de temps après professeur d'organographie végétale à la Sorbonne. Ce cours ne fut jamais pour SAINT-HILAIRE une tâche imposée, un devoir dont on s'acquitte par état. Adressées à un auditoire d'élite, ses leçons, véritablement socratiques, étaient un échange de sentiments et d'idées entre le maitre et les disciples. Lorsque la souffrance physique l'exila de cette chaire, avec quels accents de regret il rappelait ses chers élèves, ses amis de l'École normale ![8]

Ce cours fut du reste pour le professeur l'occasion de son livre favori, de l'ouvrage qui doit le faire connaitre au public instruit, et qui résume la direction générale de ses idées, la seconde période de sa vie de botaniste: nous voulons parler de sa *Morphologie végétale*.

L'histoire de la morphologie est aujourd'hui trop connue des botanistes pour que nous devions en rappeler même les grands traits. Disons seulement que l'ouvrage de SAINT-HILAIRE est l'exposition la plus simple, la plus nette, la plus méthodique, et d'ailleurs la plus séduisante, qu'on ait donnée de cette branche philosophique de l'organologie végétale.

Avant ce livre, les idées morphologiques, éparses dans les ouvrages de WOLFF, de LINNÉ, de GŒTHE, de DUPETIT-THOUARS, de TURPIN, de DE CANDOLLE, de DUNAL, sont lettre close pour le commun des botanistes, à plus forte raison pour les élèves. Dans ce livre, ces traits se concentrent en un tableau plein d'harmonie et de clarté, où l'homme du monde, avec un peu d'attention, saisit le caractère élevé des sciences naturelles, où le jeune adepte peut puiser du même coup et l'amour et la saine méthode des observations.

Dans les vingt dernières années de sa vie, SAINT-HILAIRE s'occupa sans relâche de la publication de ses voyages, œuvre éminemment consciencieuse, où l'auteur a mis ses qualités dominantes, la justesse des observations, la solidité du fond, la pureté, l'élégance de la forme, mais où se retrouvent, il faut l'avouer, plus qu'en ses autres ouvrages, les défauts de ses qualités, trop de minuties de critique, l'abus des notes et des citations, une allure un peu lente à travers l'encombrement des faits de détail, une phraséologie un peu monotone dans son irréprochable régularité. Huit volumes de ces ouvrages ont déjà paru sur les douze que devait comprendre l'œuvre entière. Parmi les quatre dont il doit rester les éléments, se trouvent les deux que l'auteur tenait le plus à finir, ceux qui devaient traiter des missions étrangères du Paraguay. Espérons que des mains intelligentes et amies ne laisseront pas dormir dans l'ombre des documents aussi précieux sur une région si peu connue.

Dans cet exposé rapide des travaux d'AUGUSTE DE SAINT-HILAIRE, nous n'avons pu signaler aux lecteurs de la *Revue* que le caractère général de ses idées et de ses œuvres. Une étude plus spéciale doit faire connaitre aux botanistes toute l'étendue de son mérite. Cette justice ne manquera pas au savant. La douleur des pauvres est un hommage de plus de prix à la mémoire de l'homme de bien.

J.-E. PLANCHON.

The two biographical sketches of SAINT-HILAIRE, just quoted, are, of course, among those cited by URBAN (SAINT-HILAIRE, AUGUSTE DE (1779-1853), *in* MARTIUS, C. F. A., Flora brasiliensis 1, pt. 1: 92-98, 1906), who gives in detail the traveller's itinerary in Brazil by years (*loc. cit.*, p. 93-98). URBAN also recorded the disposition of SAINT-HILAIRE's botanical collections, etc., as follows:

Collectio princeps (cr. 7600 numeri) in herbario musei historiae naturalis Parisiensis. Dupla in Montpellier, parca in museo Berolinensi.

Plantae non paucae a famulis Duarte et Laruotte collectae in operibus Hilarianis indicantur.

About 70 specimens collected in Brazil by SAINT-HILAIRE were received by the United States National Herbarium from the Paris Museum early in the summer of 1939.

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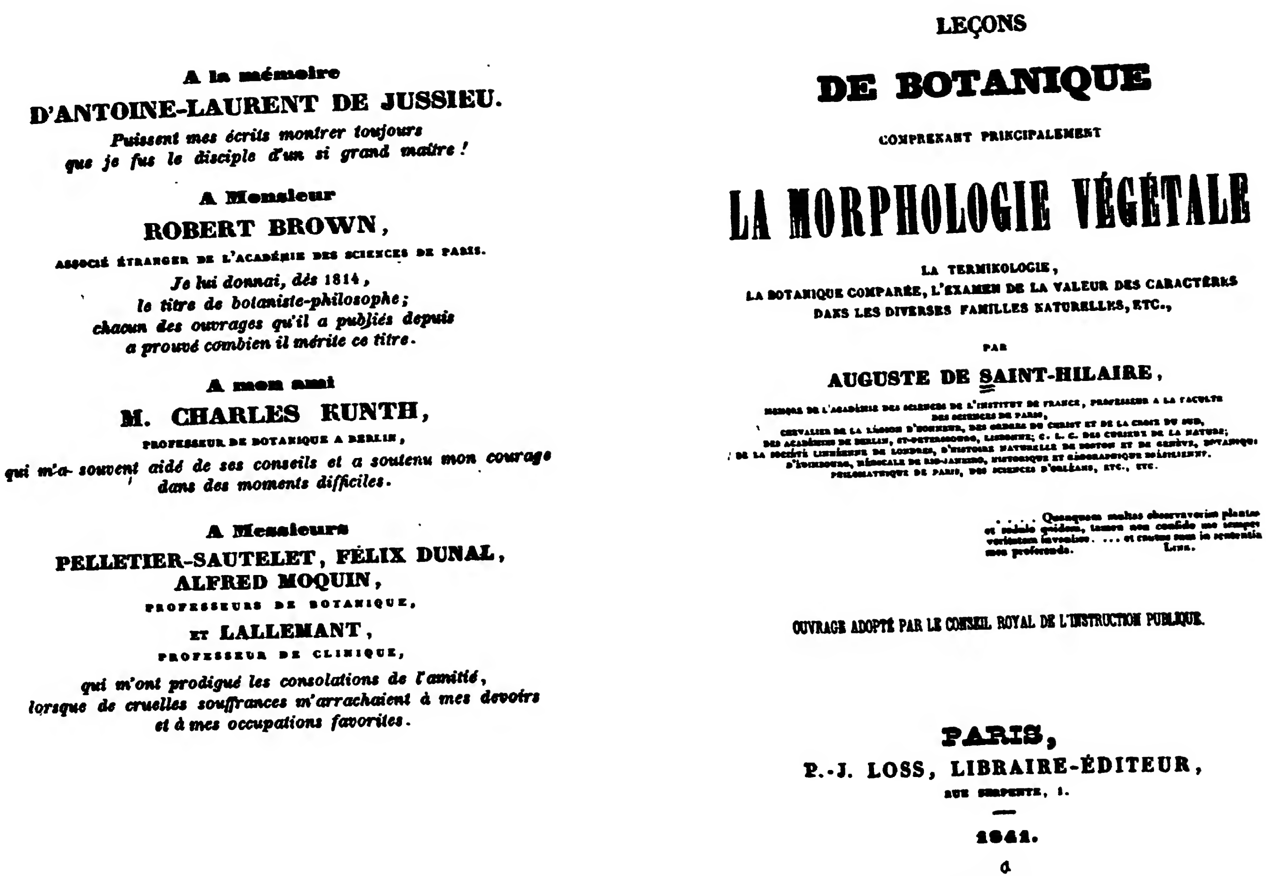
[8] For reference to SAINT-HILAIRE's influence on the scientific life of PLANCHON, *cf.* C. R. M. FLAHAULT: L'oeuvre de J. E. PLANCHON. Acad. Sci. et Let. Montpellier, Mém. Sect. Sci. 11, No. 2, xxxii p., 1892 (Reprint). — *Note by* A. E. JENKINS.



A la mémoire
D'ANTOINE-LAURENT DE JUSSIEU.
Puissent mes écrits montrer toujours
que je fus le disciple d'un si grand maître !

A Monsieur
ROBERT BROWN,
ASSOCIÉ ÉTRANGER DE L'ACADÉMIE DES SCIENCES DE PARIS.
Je lui donnai, dès 1814,
le titre de botaniste-philosophe;
chacun des ouvrages qu'il a publiés depuis
a prouvé combien il mérite ce titre.

A mon ami
M. CHARLES KUNTH,
PROFESSEUR DE BOTANIQUE A BERLIN,
qui m'a souvent aidé de ses conseils et a soutenu mon courage
dans des moments difficiles.

A Messieurs
PELLETIER-SAUTELET, FÉLIX DUNAL,
ALFRED MOQUIN,
PROFESSEURS DE BOTANIQUE,
ET LALLEMANT,
PROFESSEUR DE CLINIQUE,
qui m'ont prodigué les consolations de l'amitié,
lorsque de cruelles souffrances m'arrachaient à mes devoirs
et à mes occupations favorites.

LEÇONS
DE BOTANIQUE
COMPRENANT PRINCIPALEMENT
LA MORPHOLOGIE VÉGÉTALE
LA TERMINOLOGIE,
LA BOTANIQUE COMPARÉE, L'EXAMEN DE LA VALEUR DES CARACTÈRES
DANS LES DIVERSES FAMILLES NATURELLES, ETC.,
PAR
AUGUSTE DE SAINT-HILAIRE,
MEMBRE DE L'ACADÉMIE DES SCIENCES DE L'INSTITUT DE FRANCE, PROFESSEUR A LA FACULTÉ
DES SCIENCES DE PARIS,
CHEVALIER DE LA LÉGION D'HONNEUR, DES ORDRES DU CHRIST ET DE LA CROIX DU SUD,
DES ACADÉMIES DE BERLIN, ST-PÉTERSBOURG, LISBONNE; C. L. C. DES CURIEUX DE LA NATURE;
DE LA SOCIÉTÉ LINNÉENNE DE LONDRES, D'HISTOIRE NATURELLE DE BOSTON ET DE GENÈVE, BOTANIQUE
D'ÉDIMBOURG, MÉDICALE DE RIO-JANEIRO, HISTORIQUE ET GÉOGRAPHIQUE BRÉSILIENNE,
PHILOMATIQUE DE PARIS, DES SCIENCES D'ORLÉANS, ETC., ETC.

. . . . Quanquam multas observaverim plantas et animalia quidem, tamen non confido me semper veritatem invenisse. . . . et cautus sum in sententia mea proferenda. Linn.

OUVRAGE ADOPTÉ PAR LE CONSEIL ROYAL DE L'INSTRUCTION PUBLIQUE.

PARIS,
P.-J. LOSS, LIBRAIRE-ÉDITEUR,
RUE SERPENTE, 1.
—
1841.

FIG. 2 — Dedication and title page from SAINT-HILAIRE'S "Leçons de Botanique".

Autobiographical material of SAINT-HILAIRE is to be found in the preface to his "Voyages dans l'intérieur de Brésil (General title) (8 v. in 4, Paris, 1830-1851). The dedication accompanying the savant's "Leçons de Botanique", also of autobiographical value, stands as an example of the charm of SAINT-HILAIRE's expression (*cf.* Fig. 2). His published works available at the time are included in the botanical titles in the volume. The naturalist's scientific honors and affiliations as given below are from title pages in the "Voyages":

Membre de l'Académie royale des Sciences de l'Institut de France, Professeur à la Faculté des Sciences de Paris, Chevalier de la Légion d'Honneur, des Ordres du Christ et de la Croix du Sud, des Académies de Berlin, S. Pétersbourg, Lisbonne, C. L. C. des Curieux de la Nature, de la Société Linnéenne de Londres, de l'Institut Historique et Géographique Brésilien, de la Société d'Histoire Naturelle de Paris, de Boston, de celle de Genève, Botanique d'Edimbourg, Médicale de Rio de Janeiro, Philomathique de Paris, des Sciences d'Orléans, etc.

SAINT-HILAIRE's last travel volume, as cited by URBAN (*loc. cit.*), is as follows: "Voyage à Rio Grande do Sul. 1 vol., Orléans, 1887, cum effigie et tabula geographica omnia itinera indicante; publié par R. DE DREUZY." DREUZY's "dédicace" prefacing the volume (p. v-viii) is virtually a biographical account of SAINT-HILAIRE. It is unique in that its author evidently was an inhabitant of Turpinière (Loiret), which he gave as the place where SAINT-HILAIRE died. Other biographers of the naturalist state that he died at Orléans (Loiret). Possibly Turpinière was a small place near Orléans. It is not shown on a comparatively recent detailed map of the department of Loiret available for examination. Being of particular historical interest, as well as from a rare source (*see* p. 20), DREUZY's dedication is here quoted in full as follows:

A Son Altesse Royale et Impériale

MONSEIGNEUR LE COMTE D'EU

MONSEIGNEUR,

AUGUSTE PROUVANSAL DE SAINT-HILAIRE fut, je crois, le premier savant français auquel il ait été donné de pénétrer dans l'intérieur du Brésil.

Parti de France pour Rio-de-Janeiro, le 1er avril 1816, avec l'ambassade du duc de Luxembourg, il employa six années à des explorations diverses à travers cet immense empire du Brésil. Il ne fit pas moins de 2,500 lieues à dos de mulet dans l'intérieur du pays, visitant tour à tour le Jequitinhonha, les sources du Rio S.-Francisco, le Rio Claro et l'Uruguay.

De retour à Paris en août 1822, il dut s'occuper d'abord des résultats scientifiques de ses voyages, et commença en 1825 la publication de la *Flora Brasiliæ meridionalis*, qui lui ouvrit les portes de l'Académie des sciences.

En 1830 paraissait sa première relation intitulée: *Voyage dans les provinces de Rio-de-Janeiro et Minas Geraes;* et en 1833 la deuxième, intitulée: *Voyage dans le district des Diamans et sur le littoral du Brésil.*

Le 1er février 1821, sur les bords du ruisseau Guarapuità, près Belen, non loin des bords de l'Uruguay, il fut empoisonné par le miel de la guêpe Lechiguana et fit toujours remonter à cet accident l'origine de la longue et cruelle maladie qui retarda la publication de la troisième et de la quatrième partie de son voyage.

Ces deux ouvrages ne parurent qu'en 1848 et 1851 sous ces titres: *Voyage aux sources du Rio S.-Francisco et dans la province de Goyaz* et *Voyage dans les provinces de S.-Paul et Sainte-Catherine.*

Il mourut en 1853 à la Turpinière (Loiret), membre de l'Académie des sciences de l'Institut de Paris, professeur à la Faculté des sciences de Paris, Chevalier de la Légion-d'Honneur, des ordres du Christ et de la Croix du Sud, etc.

Un autre honneur lui était réservé.

Sa Majesté l'Empereur du Brésil, dans une audience particulière accordée à un Orléanais attaché à l'ambassade de France, voulut bien manifester spontanément l'estime qu'Elle avait pour le savant dont le nom et les travaux étaient présents à sa mémoire.

Pour obéir aux dernières volontés d'Auguste de Saint-Hilaire, je publie actuellement la dernière partie de ce long voyage. C'est le journal rédigé chaque soir pendant une pénible exploration dans la province de Rio-Grande do Sul, poursuivie jusqu'à Montevideo, sur les bords de l'Uruguay et à travers les anciennes missions jésuitiques de cette contrée*.

Ce journal de voyage, à cause même de sa date déjà ancienne, devra présenter aux lecteurs brésiliens un intérêt presque archéologique. Le temps et le progrès marchent si vite dans l'empire du Brésil, qu'il sera curieux, ce me semble, de posséder une description consciencieuse et détaillée, une sorte d'inventaire dressé en 1821 des lieux et des pays visités par l'auteur.

C'est ce qui m'encourage, Monseigneur, à solliciter de Votre Altesse la faveur de pouvoir inscrire son nom en tête de ce livre.

Cet auguste patronage serait un insigne honneur rendu à la mémoire du savant consciencieux qui avait voué au Brésil une affection sincère, qui n'y avait laissé que de bons souvenirs avec de précieuses amitiés et qui avait consacré à ce beau pays une grande partie de ses travaux et de son existence.

Daignez agréer, avec cette dédicace,
Monseigneur,
l'hommage du profond respect avec lequel
j'ai l'honneur d'être de
Votre Altesse Royale et Impériale
le très humble et très obéissant serviteur.
R. DE DREUZY.

La Turpinière, 3 *janvier* 1884.

En réponse à cette dédicace, Madame la Comtesse d'Eu daignait, le 5 mars 1884, nous faire savoir que Monseigneur le Comte d'Eu « *accepte avec plaisir la dédicace de la publication qui doit compléter les voyages d'Auguste de Saint-Hilaire. Le nom de ce savant est bien connu au Brésil, et ses travaux, qui ont fourni tant de renseignements sur une grande partie du pays, y jouissent depuis longtemps de la plus grande estime.*

« *C'est donc avec grand plaisir que nous apprenons que ce précieux ouvrage va être complété par un dernier volume.* »

Ces lignes sont la plus précieuse récompense de notre travail d'éditeur, et émanant de princes aussi eclairés, elles sont aussi une haute recommandation pour le lecteur.

As documented, the portrait of Saint-Hilaire in "Voyage à Rio Grande do Sul" (frontispiece) is a print from an engraving by Teyssonnières, which in turn is from the portrait painted by Naissant. The legend beneath the frontispiece portrait reads:

"A. F. C. de Saint-Hilaire, membre de l'Institut, professeur de botanique au Muséum, né à Orléans le 4 Octobre 1779—Mort à La Turpinière le 30 Septembre 1853."

The portrait of Saint-Hilaire shown on the accompanying frontispiece, with the source there acknowledged, doubtless is based on the print just mentioned, as evidently are various other line cuts of the traveller in Brazil published in that country more or less recently.

* J'ai cru devoir respecter l'orthographe des noms brésiliens, telle qu'elle avait frappé l'oreille de l'auteur et qu'elle se trouve reproduite dans ses manuscrits. Ainsi il écrit *Jiquitinhonha*, bien que l'usage ait consacré depuis la forme *Jequitinhonha*.

SAINT-HILAIRE's "Itinéraire des cinq voyages accomplis dans l'intérieur du Brésil 1816-1822" is delineated in blue on the detailed folded map bound at the back of the "Rio Grande do Sul" volume (Fig. 3). On the extended right margin is a chronological list of places visited and the time spent in each (*see* Table, p. 13).

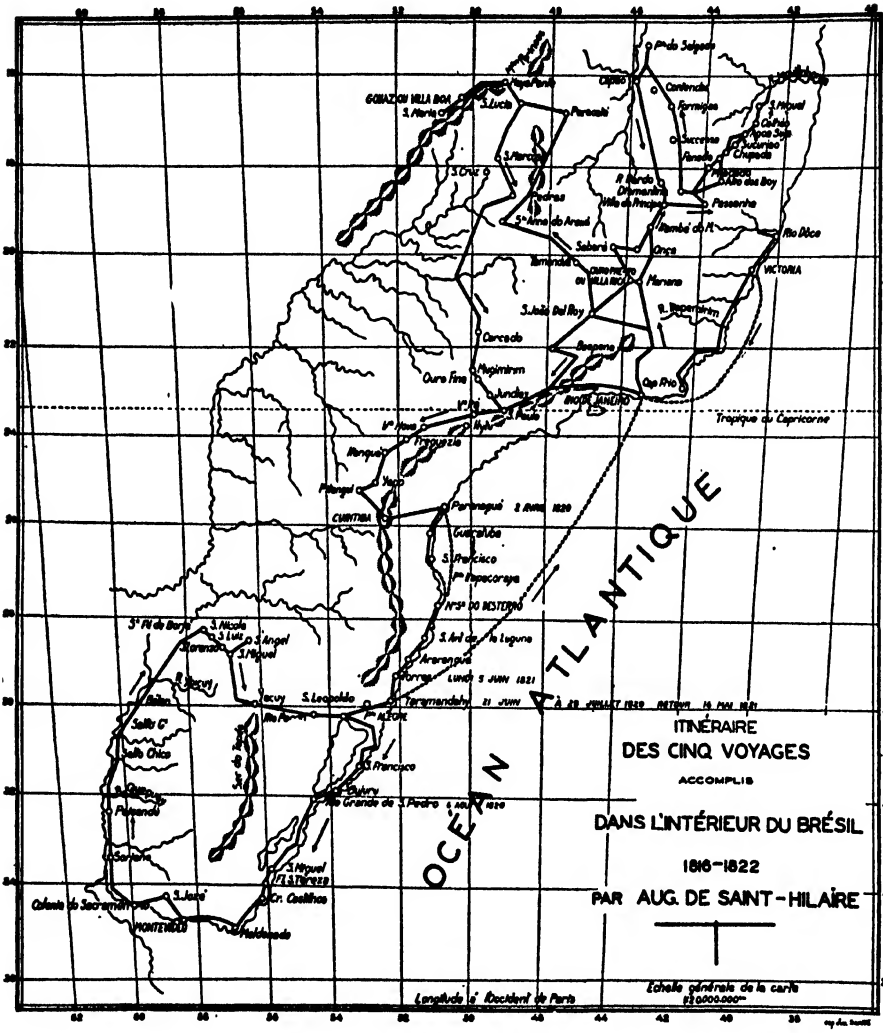


FIG. 3. — SAINT-HILAIRE's itinerary in Brazil (1816-1822), based on detailed map in his "Voyage à Rio Grande do Sul." This simplified draft by J. SANTOS, 1944, was made under the direction of A. A. BITANCOURT as a contribution to the present article.

The "Aperçu d'un voyage dans l'intérieur du Brésil," cited in the Linnean Society's biographical notice (*see* p. 5) is SAINT-HILAIRE's report of his trip which he read before the Académie des Sciences upon his return to France. An extra page inserted at the front of an extract of this report (Paris, 1823) bears the dedication "Aux Brésiliens Hospitaliers."

Chronological List of Places Visited by Saint-Hilaire and the time spent in each:—

DÉPART DE FRANCE, 1er avril 1816

1er VOYAGE

RIO DE JANEIRO, 7 décembre 1816.
VILLA-RICA, 26 décembre 1816 - 9 janvier 1817.
VILLA DO PRINCIPE, 13 mars - 9 avril 1817.
VILLA DO FANADO, 16, 17 mai 1817.
RIO EQUITINHONHA, 29 mai - 11 juin 1817.
VILLA DO FANADO, 3-7 juillet 1817.
FORGES DE BOM FIM, 15-20 juillet 1817.
CONTENDAS, 8-14 août 1817.
SALGADO SUR LE R. S.-FRANCISCO, 22-28 août 1817.
SERVIÇO DOS DIAMANTES, 24-28 septembre 1817.
TIJUCO, 29 septembre - 30 octobre 1817.
VILLA DO PRINCIPE, 3-12 novembre 1817.
SABARÀ ET VILLA-RICA, janvier 1818.
RIO DE JANEIRO, 17 mars 1818.

2e VOYAGE

RIO DE JANEIRO, 18 août 1818.
LAC SAQUARÉMA, 20 août 1818.
ALDEA DE S.-PEDRO,
VILLA DO CABO-FRIO,
S.-SALVADOR DOS CAMPOS-GOITACAZES, 24 septembre 1818.
VILLA DA VICTORIA (ESPIRITU-SANTO), 10 octobre 1818.
VILLA D'ALMEIDA O DOS 3 REIS-MAGOS, 15 octobre 1818.
BORDS DU RIO-DOCE, 18 octobre 1818.
NAVIGATION SUR LE RIO-DOCE.
RETOUR À VILLA D'ALMEIDA 1er novembre 1818.
VILLA DA VICTORIA, EXCURSION À VIANNA.
RETOUR PAR MER DE VILLA DA VICTORIA À RIO-DE-JANEIRO EN 4 JOURS.

3e VOYAGE

RIO-DE-JANEIRO, 26 janvier 1819.
S.-JOÃO-DEL-REY, 21 février - 19 mars 1819.
SERRA DO CANASTRO, SOURCES DU RIO S.-FRANCISCO, 10 avril 1819.
VILLA D'ARAXÀ, 23-26 avril 1819.
PARACATÚ, 14-22 mai 1819.
MONTES PYRENEOS, 13 juin 1819.
MEIAPONTE, 14-17 juin 1819.
VILLA BOA OU GOYAZ, 26 juin - 3 juillet 1819.
RIO DOS PILÕES, 12-15 juillet 1819.
GOYAZ, 20-28 juillet 1819.
MEIAPONTE, 8 août 1819.
PORTO-REAL DA PARANAHYBA, 4 septembre 1819.
RIO DAS VELHAS, 9, 10 septembre 1819.
BORDS DU RIO-GRANDE, 24 septembre 1819.
RIO PARDO, 9, 10, 11 octobre 1819.
VILLA DE MOGIMIRIM, 19 octobre 1819.
VILLA DE CAMPINAS OU S.-CARLOS, 22, 23 octobre 1819.
VILLA DE JUNDIAHY, 25, 26 octobre 1819.
S.-PAUL, 29 octobre 1819.

4e VOYAGE

S.-PAUL, 9 décembre 1819.
VILLA D'HYTU, 16, 16 décembre 1819.
SOROCABA, FORGES D'IPANEMA, 21 décembre 1819 - 6 janvier 1820.
VILLA D'ITAPITININGUA, 10 janvier 1820.
VILLA D'ITAPERA, 21, 22 janvier 1820.
RIO JAGUARIAHYBÁ, 31 janvier - 4 février 1820.
VILLA DE CASTRO, 19-28 février 1820.
ITAQUE, 9-11 mars 1820.
CURITIBA, 14-21 mars 1820.
PARANANGUA, 28 mars 3 avril 1820.
NAVIGATION PAR MER.
VILLA DO RIO-S.-FRANCISCO, 8-21 avril 1820.
SAINTE-CATHERINE, 27 avril - 18 mai 1820.
VILLA DA LAGUNA, 23-31 mai 1820.
PORTO-ALEGRE, 21 juin - 28 juillet 1820.
RIO GRANDE DO SUL, 6 août - 4 septembre 1820.
CASTILHOS, 10, 11 octobre 1820.
MALDONADO, 21 octobre 1820.
MONTEVIDEO, 29 octobre - 28 novembre 1820.
COLONIA DO SACRAMENTO, 9 décembre 1820.
RINCÃO DAS GALINHAS, 27-29 décembre 1820.
PAI SANDÙ, 3 janvier 1821.
SALTO, 11-15 janvier 1821.
BÉLEN, 16-18 janvier 1821.
SOURCES DU GUARAPUITÀ, 1, 2 fevrier 1821. (Empoisonnement par le miel de la guêpe Lechinguana.)
BORDS DE L'IBICUI, 9-12 février 1821.
S.-BORJA, 19-22 février 1821.
S.-NICOLAO, 9, 10 mars 1821.
S.-LUIZ, 13, 14 mars 1821.
S.-LORENZO, 16 mars 1821.
S.-MIGUEL, 17-20 mars 1821.
S.-JOAO, 21 mars 1821.
S.-ANJO, 23 mars 1821.
S.-XAVIER, 2 avril 1821.
VILLA DA CAXUEIRA, 22 avril 1821.
VILLA DO RIO-PARDO, 29 avril - 12 mai 1821.
NAVIGATION SUR LE RIO JACUI JUSQU'À PORTO-ALEGRE, 10 mai - 13 juin 1821.
RETOUR À RIO-DE-JANEIRO PAR MER.

5e VOYAGE

RIO-DE-JANEIRO, 28 janvier 1822.
S.-JOAO DEL REY, 23, 24 février 1822.
SERRA DO PAPAGAIO, JURÚOCA, 7-9 mars 1822.
VILLA DE BAEPENDI, 10 mars 1822.
SERRA MANTIQUERA, 19 mars 1822.
VILLA DA GUARATINGUETA, 23 mars 1822.
VILLA DE THAUBATÉ, 25 mars 1822.
S.-PAUL, 3-11 avril 1822.
THAUBATÉ, 17 avril 1822.
RIO-DE-JANEIRO, 5 mai 1822.

RETOUR EN FRANCE, 1ers jours d'août 1822.

The Academy's formal acceptance of SAINT-HILAIRE's "Aperçu d'un Voyage . . ." is entitled "Rapport sur le Voyage de M. AUGUSTE DE SAINT-HILAIRE dans le Brésil et les Missions du Paraguay." (Paris, 8 p., 1823).[4] Under the title "Notice sommaire des voyages de M. DE SAINT-HILAIRE dans le Brésil," essentially this same statement was published in "Nouvelles Annales des Voyages" (17: 228-256, 1823), although often not word for word. The first paragraph of this historical report by the Academy explains succinctly the objectives of the trip and the extent of the work undertaken by SAINT-HILAIRE. It is here quoted as follows:

Nous avons été chargés par l'Acádemie (Mm. DESFONTAINES, LATREILLE, GEOFFROY SAINT-HILAIRE, BRONGNIART et DE JUSSIEU) de lui faire l'exposé des travaux entrepris et exécutés par M. AUGUSTE DE SAINT-HILAIRE dans son voyage au Brésil, pour observer et recueillir les productions naturelles de ce pays. Un séjour de six années au Brésil, une grande étendue de terrain parcourue en divers sens et sous divers climats, des collections nombreuses en animaux, végétaux et minéraux, des descriptions exactes faites sur les lieux, des observations générales sur les climats, les sites, les moeurs des habitans, les productions naturelles à chaque contrée, la nature des terrains et le genre de culture approprié à chacune; tels sont les résultats du voyage de M. DE SAINT-HILAIRE, lesquels exigeraient de trop longs détails pour faire apprécier exactement les services rendus à la science par ce voyageur naturaliste. Nous sommes obligés de ne présenter ici qu'un aperçu, suffisant cependant pour prouver qu'il a rempli sa mission de la manière la plus utile à la science et la plus honorable pour lui.

Following this introduction is a description of the five "voyages", then a summary of the naturalist's collections emanating from them. The summary is quoted here, together with the remainder of the text in which the need is expressed for governmental means suitably to record the results, particularly botanical, of the long sojourn.

C'est au commencement de juin 1822, après six années de séjour en Amérique, après avoir fait environ 2,400 lieues portugaises dans des climats différens, depuis le 12° jusqu'au 34° degré, qu'il s'embarqua pour l'Europe, où il eut le bonheur d'arriver avec toutes ses collections, déposées maintenant au Muséum d'Histore (sic) naturelle.

D'après le relevé sommaire qui y a été fait par les professeurs de cet établissement, on peut présenter l'aperçu suivant:

1° La collection contient un petit nombre de minéraux parmi lesquels sont quelques roches remarquables; un euclase d'un assez gros volume, des fragmens de fer oligiste micacé, d'autres de fer oligiste compacte très-abondant au Brésil et renfermant de l'or disséminé, un pouding ferrugineux et siliceux, nommé *cascalho dos diamantes,* ou caillou des diamans, qui sert d'enveloppe ou de gangue à cette pierre précieuse dans le Brésil, et qui est de même nature que celle qui renferme les diamans de l'Inde: on ne le connaissait pas encore en Europe, parce que l'entrée du District des diamans est sévèrement défendue.

2° 129 individus d'animaux mammifères rapportés à 48 espèces, dont 13 manquaient à la collection du Muséum, et dans ce nombre sont deux chauves-souris, un nouveau singe hurleur, l'*aguarachay,* espèce de chacal connu seulement par les descriptions d'AZZARA, un *porc-épi* à queue prenante, un nouvel *apérea* nommé *moco.*

3° 2,005 oiseaux formant 451 espèces, dont 156 nouvelles pour les galéries du Muséum. La plupart de celles-ci nous font mieux connaitre les espèces décrites par AZZARA, et facilitent les moyens de les placer convenablement dans le système ornithologique. On doit remarquer dans ce nombre le *chaja,* auparavant mal connu, voisin du camichi dans le genre parra; une espèce de *rhynchée,* qui offre le premier exemple d'une forme propre aux Indes orientales et retrouvée en Amérique; le *cygne blanc à col noir du Paraguay;* le *psittacus hyacinthinus,* dont il n'existe que deux ou trois individus dans les cabinets de l'Europe; l'*aigle couronné;* plusieurs espèces de

[4] For access to a reprint of this rare historical report the writer is indebted to the Oliveira Lima Library, Catholic University, Washington, D. C.

tangara connues seulement par AZZARA, ainsi que le *guirayetapa* ou petit coq, ainsi nommé parce que, gros à peine comme nos moineaux, il a la queue relevée comme nos coqs domestiques.

4° 35 individus de reptiles, réduits à 21 espèces, parmi lesquelles est une seconde espèce de *lachesis,* genre de serpens vénimeux dont on n'en connaissait qu'une.

5° 58 individus de poissons, dont 21 espèces, la plupart nouvelles, habitant les eaux douces, parmi lesquelles sont trois *chalcées* et le *pimelade oxyringue.*

6° Quelques coquilles, dont une nouvelle espèce *d'unio,* trouvée dans le Rio Doce, et une nouvelle *ampulaire,* dont la spire tourne à gauche.

7° Environ 16,000 insectes conservés avec soin, dont M. LATREILLE juge que près de 800 n'étaient pas connus.

8° Un très-grand nombre de paquets de graines, indépendamment de ceux qui avaient été auparavant envoyés à diverses époques, lesquels avaient déjà produit de nouvelles richesses dans le Jardin du Roi.

9° Un herbier composé d'environ 30,000 échantillons, formant près de 7,000 espèces de plantes bien conservées, dont M. DESFONTAINES estime que les espèces nouvelles peuvent s'élever aux deux tiers, parmi lesquelles seront des genres nouveaux et peut-être des familles nouvelles, dont une, celle des *vochisiées,* parvenue dans un envoi précédent, est déjà publiée dans le recueil du Muséum.

Nous ajouterons que M. DE SAINT-HILAIRE, tenant un journal exact de son voyage, a pris tous les renseignemens qu'il a pu se procurer sur la statistique des pays visités par lui, sur les mœurs des habitans, leurs langages, leur commerce, leurs habitudes, etc. Voyageant plus spécialement pour la recherche des végétaux, il a fait la description des espèces recueillies, surtout de celles dont les Brésiliens font usage dans la médecine et les arts. Il a rassemblé toutes les notes nécessaires pour établir la concordance de leurs noms vulgaires avec les noms botaniques.

Il serait à désirer que le gouvernement voulût bien, par les moyens qui sont à sa disposition, favoriser la publication de ces objets nouveaux et l'exécution des dessins et gravures qui doivent être joints à ce grand ouvrage. Cette publication serait d'autant plus utile, surtout pour la partie botanique, que M. DE SAINT-HILAIRE a dans cette science des connaissances positives et très-étendues.

Signé, GEOFFROY SAINT-HILAIRE, DESFONTAINES, LATREILLE, BRONGNIART; DE JUSSIEU, Rapporteur.

L'Académie approuve le Rapport et en adopte les conclusions.

Certifié conforme,

Le Secrétaire perpétuel, conseiller-d'état, commandant de l'ordre royal de la Légion-d'Honneur.

Signé, Baron CUVIER.

L'Académie royale des sciences décide ensuite à l'unanimité que le Rapport ci-dessus sera adressé à Son Excellence le Ministre de l'Intérieur.

It is apparent that the French government granted the assistance requested. What was not foretold, however, was that even with this advantage, the botanical researches based on the specimens collected during SAINT-HILAIRE's pioneer travels in Brazil would terminate before completion owing to the nervous debility that was to undermine his health within four years' time.

In publishing his "Histoire des plantes les plus remarquables du Brésil" (cited on p. 5, also *cf.* fig. 5), SAINT-HILAIRE stated in the "Avant-propos":

Quelques Monographies me conduiront à faire figurer des espèces remarquables tantôt par le grandeur et la beauté de leurs fleurs, tantôt par la singularité de leurs formes. Je décrirai principalement les plantes qui je dois citer dans la *Relation de mon Voyage;* et, se rattachant aussi l'un à l'autre, ces deux ouvrages auront, j'ose l'espérer, un plus grand interêt. . . . L'*Histoire des Plantes les plus remarquables du Brésil et du Paraguay* est le fruit d'un travail auquel j'ai sacrifié de longues années. . . .

"Esquisse des Voyages de l'auteur, considérés principalement sous de rapport de la botanique," which serves as the "Introduction" to this botan-

ical research of 355 pages and 30 plates (Paris, 1824) is virtually the "Aperçu d'un voyage de l'auteur . . ." There are certain modifications in the early part of the text, the most notable being the substitution of a new introductory paragraph and the inclusion of an entirely new paragraph (paragraph 6, beginning with "Accoutumé à"). The original introductory paragraph reads:

"Après avoir parcouru pendant six ans une vaste portion du Brésil, la province Cisplatine* et les Missions dites du Paraguay, je vais m'occuper sans relâche à coordonner les divers matériaux que j'ai rassemblés et qui concernent principalement la botanique. Mais avant même que mes collections soient entièrement classées et que mes notes soient toutes réunies, je crois qu'il est de mon devoir de soumettre à l'Académie un léger aperçu de mon voyage."

It was in the course of the preparation of the first volume of the "Flora Brasiliae Meridionalis" (*loc. cit.* p. 5) that SAINT-HILAIRE became ill and, to continue the work, enlisted the assistance of ADRIEN DE JUSSIEU and CAMBESSÈDES. In this volume, p. 171, 1827, we find an "Advertissement" signed by SAINT-HILAIRE on January 15, 1827, from which the following is quoted:

L'altération de ma santé m'a forcé d'interrompre cet ouvrage, et comme elle n'est malheureusement point encore rétablie, j'ai cru devoir m'adjoindre des collaborateurs. Les deux hommes qui veulent bien réunir leurs efforts aux miens, MM. ADRIEN DE JUSSIEU et CAMBESSÈDES, offrent la plus belle garantie à ceux qui chercheront dans cette Flore une véritable instruction. En débutant dans la carrière, M. CAMBESSÈDES a montré qu'il était imbu des plus saines doctrines, et qu'on pouvait attendre de lui des travaux utiles. Digne héritier d'un nomme illustre, M. ADRIEN DE JUSSIEU a déjà prouvé qu'il était donné d'un véritable esprit d'observations, et qu'étranger à l'amour des systèmes, il étendrait de la domaine de la science, en suivant la route tracée par son père et par l'immortel RICHARD. . . . "

Turning the pages of volume 3 of this botanical work, we come to the title page of the last fascicle. Dated 1833, this bears only SAINT-HILAIRE's name as author. The page following carries the explanation as follows:

Comme les circonstances qui m'avait engagé à m'adjoindre des collaborateurs n'existent plus, seul désormais je resterai chargé de la publication de cet ouvrage. Je ne pourais être secondé par des hommes plus habiles que ceux que avait bien voulu se réunir à moi; qu'ils me permettent de leur offrir ici l'expression de ma reconnaissance.

Below these words, it is explained in handwriting that the volume was not completed because of the ill health of the able botanist, AUGUSTE DE SAINT-HILAIRE.

In his "Notice sur la vie et les travaux de JACQUES CAMBESSÈDES" (Bul. Soc. Bot. de France 10: 543-565, 1863) PLANCHON evaluates the "Flora Brasiliae Meridionalis" (*loc. cit. see* p. 5), in the following terms:

. . . . Rivalisant avec le grand ouvrage de KUNTH sur les plantes de HUMBOLDT et BONPLAND, l'égalant par l'exactitude des descriptions, par la manière à la fois large et précise de considérer les genres, le dépassant même par l'adjonction des considérations d'ensemble, la première œuvre, malheureusement inachevée, reste un modèle dans le genre descriptif. De beaux dessins y rendent, avec une élégante exactitude, les traits des espèces remarquables, avec une précision rigoureuse, les détails intimes de leur organisation. (*cf.* Fig. 4).

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* La province Cisplatine est cette portion de l'ancien Paraguay qui se trouve comprise entre la mer, le Rio de la Plata, l'Uruguay, les Missions et la capitainerie de Rio-Grande. Elle a été réunie au royaume du Brésil par un acte de ses députés convoqués le 15 juin 1822.

In PLANCHON's (*loc. cit.*, 1863, p. 552) further interesting comment upon this joint endeavor, he quotes from two letters from SAINT-HILAIRE to CAMBESSÈDES:

. . . . entre gens faits pour s'estimer et dignes de se comprendre, la science établissait un courant commun de vues et d'expressions, qui donnait à cette œuvre multiple un caractère d'unité bien rare dans les travaux collectifs; on y sent les mêmes principes, puisés à la même école. SAINT-HILAIRE, malade, éloigné de Paris, fait de prodigieux efforts d'esprit pour maintenir cette unité. Le talent de ses collaborateurs lui rend facile cette tâche ingrate. S'il insiste avec un soin minutieux sur l'exactitude des noms des localités brésiliennes, s'il explique de loin ce qui peut rester obscur dans ses notes de voyageur, il n'en approuve pas moins dans son ensemble la manière de ses jeunes aides, et ne ménage pas, à CAMBESSÈDES en particulier, ses encouragements et ses éloges. « J'ai lu vos descriptions, écrit-il en septembre 1827, et je ne puis que » vous en faire compliment. Elles sont comme je les aime, claires; on les lit sans » peine, et elles me paraissent bien peindre les objets. Votre manière se rapproche » de la mienne; je serais tenté d'en concevoir de l'amour-propre, si cela convenait » à un pauvre souffreteux. » Et plus tard, en novembre 1828, à propos de descriptions de Sapindacées: « Cela est bien, très-bien; j'y trouve tout ce qui me plaît dans une » description: ordre, clarté, choix heureux d'expressions. Ne changez point de mé- » thode, sous prétexte de faire mieux; faites comme vous avez fait, et le mieux, si » vous ne l'avez pas atteint, viendra tout seul, sans que vous vous en aperceviez. On » peut actuellement vous compter parmi ceux qui ont le mieux décrit. »

PLANCHON (*loc. cit.*, 1854, p. 180) stated that SAINT-HILAIRE devoted the last two decades of his life to the preparation of his "Voyages" for publication. The prefaces of these volumes reveal the author's broken health.

Thus we read in the preface to Part 1, volume 1, p. XIII:

Quelques temps après mon retour [du Brésil] ma santé s'altéra; je fus obligé de suspendre mes travaux, et je vins chercher dans le midi de la France un climat plus analogue que celui de Paris à la température sous laquelle j'avais vécu si longtemps. Aussitôt que . . . . j'ai pu reprendre mes travaux, je me suis occupé de cette Relation . . . .

Again, in his preface to Part 3, volume 1, p. V, signed at Montpellier, France, on January 10, 1848, SAINT-HILAIRE explained the long delay in the publication of this part of the report of his trip as follows:

J'avais trop présumé de mes forces: quant je revins du Brésil, elles étaient épuisées, et bientôt je fus obligé d'interrompre mes travaux. Quinze années environs que je leur aurais consacrées m'ont été enlevées, à trois différentes reprises, par des souffrances cruelles, et, par conséquent, il ne pas être surpris que j'aie mis de si longs intervalles entre mes diverses publications.

In this same preface (p. XIV), SAINT-HILAIRE mentioned "l'ouvrage que j'ai commencé sur S. Paul et Sainte-Catherine." Continuing, he alluded to the unprepared report of the trip to Rio Grande do Sul. To quote:

Un écrivain qui rendit de grands services à son pays, mon ami M. JOSÉ FELICIANO FERNANDEZ PINHEIRO, baron de S. Leopoldo, que tout le Brésil a regretté, m'engageait avec instance, il y a bien peu de mois encore, à publier la relation du voyage que j'ai fait dans la province de Rio Grande de S. Pedro do Sul, province où je l'ai connu dont il a si fidèlement retracé l'histoire.[5] Si un peu de temps m'est accordé, je regarderai comme une sorte de devoir de remplir ses intentions.

[5] J. F. F. PINHEIRO, Annaes da provincia de São Pedro, Paris, 1839 (*cf.* "Bibliografia citada por SAINT-HILAIRE," pp. 365-369 (*In* AUGUSTE DE SAINT-HILAIRE, Viagem à Provincia de São Paulo e resumo das Viagens ao Brasil, Provincia Cisplantina e Missões do Paraguai, traducão e prefacio (p. 5-16) de RUBENS BORBA DE MORAES (São Paulo, 1940).)

Apropos of PINHEIRO's account, is SAINT-HILAIRE's "Province de S. Pedro de Rio Grande do Sul au Brésil,"[6] which bears the subtitle: "Rapport sur l'ouvrage intitulé: Annaes da Provincia de S. Pedro, par . . . PINHEIRO, . . ., ancien ministre d'état de l'empire du Brésil."

The concluding paragraph in the preface quoted from above, reflects the effort made by SAINT-HILAIRE, under waning strength, to complete the "journal exact de son voyage." Thus we read:

"La protection que M. le ministre de l'instruction publique veut bien accorder à cet ouvrage est encore un puissant motif pour m'engager à redoubler d'efforts et à continuer mes travaux. Mais je ne saurais me le dissimuler, quelque chose qui arrive, la plus grande partie des recherches que j'ai faites sur le Brésil sera perdue, et je serais presque tenté de m'écrier avec un écrivain célèbre, qui, lui, aussi a longtemps vécu dans des contrées lointaines: "Heureux ceux que ont fini leur voyage sans avoir quitté le port, et qui n'ont pas, comme moi, trainé d'inutiles jours sur la terre.*"

SAINT-HILAIRE's account of the reception accorded him when he visited Curitiba, naturally is placed in the "Voyage dans les provinces de S. Paul et de Sainte-Catherine" (*His* "Voyages" pt. 4, v. 2:138-139). This delightful example of "Brazilian hospitality" is a pleasure to read and is quoted below:

On va voir à présent combien j'ai eu à me louer de l'accueil que me firent les bons Curitibanais.

Lorsque, venant de Ferraria, j'étais sur le point d'arriver à Curitiba, je vis une troupe de gens à cheval qui venaient au devant de moi, presque tous en uniforme. C'étaient le *capitão mór,* un colonel et plusieurs officiers du régiment de milice. Ces messieurs m'abordèrent avec une extrême politesse, et, à mon grand désespoir, je fus traité d'excellence, comme cela m'était déjà arrivé quelquefois. Nous passâmes, sur un pont composé de quelques planches, le très-petit ruisseau dont j'ai déjà parlé, nous entrâmes dans la ville et nous nous rendîmes à la maison du *capitão mór.* On y servit un fort beau dîner auquel avaient été invités tous ceux qui étaient allés au-devant de moi. La viande était excellente, et chacun avait devant soi un petit pain très-blanc et fort bien fait. Après le dîner, le *capitão mór* m'offrit de choisir entre une maison à la ville ou une maison de campagne qui en était peu éloignée. Je dis que je préférais cette dernière, et j'y fus conduit par toute la société. Quand je fus installé, le *capitão mór* et les autres officiers se retirèrent, en laissant à ma porte un garde national chargé, me dit cet homme, de prendre mes ordres. Je causai quelques instants avec lui, je lui fis des politesses et je le congédiai.

Il est impossible de rien voir de plus délicieux que la position de la maison de campagne où l'on m'avait logé. [*cf.* vignette, title page] Située sur une colline à peu de distance de Curitiba, elle domine toute la plaine où cette ville est bâtie. L'horizon est borné par la Serra de Paranaguá, qui forme le demicercle, et dont les sommets s'arrondissent en croupes ou s'élancent comme des pyramides. La plaine est ondulée et offre une agréable alternative de pâturages verdoyants et de bois au milieu desquels se fait toujours admirer le majestueux et pittoresque *Araucaria.* Sur la gauche on voit, à l'entrée d'un bois, un petit lac au bord duquel sont quelques maisonettes, et dans le lointain on découvre, au sud-est, la paroisse de S. José dos Pinhaes. La ville de Curitiba ne s'aperçoit pas; située dans un enfoncement, elle est cachée par une petite colline sur laquelle a été bâtie la chapelle dont j'ai parlé plus haut.

Je passai neuf jours à Curitiba, comblé de politesses par le *capitão mór* et les principaux habitants; depuis que j'étais au Brésil, je n'avais certainement été mieux reçu nulle part. Le lendemain et le surlendemain de mon arrivée, les personnes les plus notables du pays vinrent, suivant l'ancien usage, me rendre visite, et je ne manquai pas, avant mon départ, d'aller les remercier.

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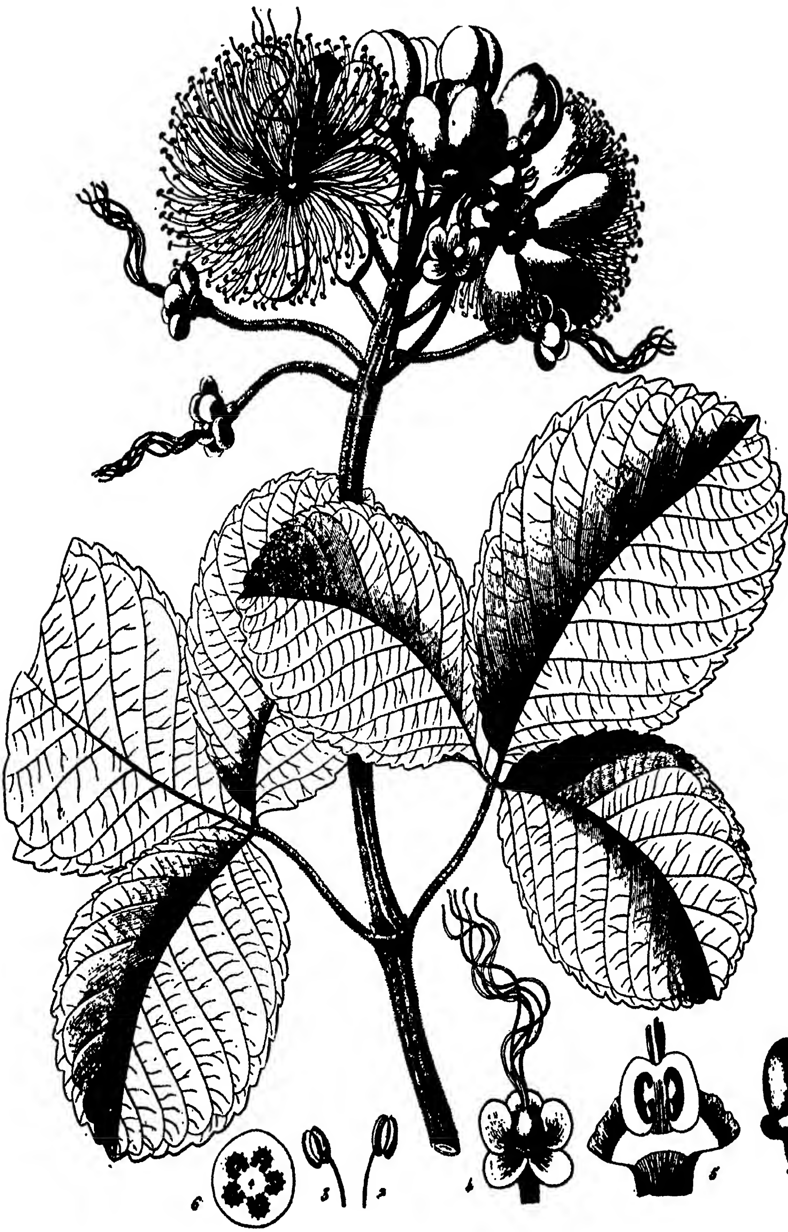
[6] The copy of this article of 22 pages, as available at the Oliveira Lima Library, is undated. It is not cited among the "Bibliografia das principais obras de SAINT-HILAIRE" assembled by MORAES (*loc. cit.,* p. 373-375).

* CHATEAUBRIAND.



Caignet sculp.

CARYOCAR brasiliense.

E.D. del.

FIG. 4.—Plate accompanying CAMBESSÈDES' description of *Caryocar brasiliense* (Fl. Bras. Merid. 1:332), here reproduced as an example of what PLANCHON (*loc. cit.*, 1863, p. 551) referred to as the "beaux dessins" illustrating the multiple work "Flora Brasiliae Meridionalis. (*Courtesy Arnold Arboretum of Harvard University.*)

SAINT-HILAIRE did not live to prepare the report of his trip to Rio Grande do Sul, but, as already seen, under the editorship of one R. DE DREUZY, a single volume entitled "Voyage à Rio Grande do Sul (Brésil)" was published more than three decades after the savant's death. This contains the original journal from June 5, 1820, to the close of the Brazilian trip, June 1822.

It is probable that from this diary SAINT-HILAIRE would have prepared the four travel volumes that PLANCHON (*loc. cit.*, 1854, p. 180) stated remained to be completed. In that case the twelfth and final volume would probably have reported the second trip from Rio to Minas Gerais and São Paulo, which was his last in Brazil. This fifth trip in that country has been translated into Portuguese from the "Voyage à Rio Grande do Sul," by AFONSO DE E. TAUNAY, under the title "Segunda Viagem de Rio de Janeiro à Minas Geraes e à São Paulo (1822)" (São Paulo, 242 p., 1932). In his prefatory remarks TAUNAY states that the "Voyage à Rio Grande do Sul" is much more of a rarity than any of the other travel volumes by SAINT-HILAIRE. The explanation, he supposes, is that it was printed in a smaller edition. It sells for an incomparably higher price, he adds. In the United States this rare volume is available only in the Oliveira Lima Library, Catholic University, Washington, D. C., where the writer has enjoyed the privilege of consulting it.

SAINT-HILAIRE's sincere affection for Brazil, after six years of travel in the country, and his regret at leave-taking are expressed in his own words in his diary for February 14, 1822. He was then making the second visit to Minas Gerais. He wrote:

> A la vue des belles campagnes qui se sont offertes aujourd'hui à mes regards, je n' ai pu me défendre d'un serrement de coeur en songeant que bientôt je m'en éloignerais sans retour. Tous ces jours-ci j'ai été livré à la plus pénible incertitude. Je sens très bien, il est vrai, que je ne puis rester toujours au Brésil; mais j'aurais désiré du moins pouvoir jouir plus longtemps du plaisir d'admirer ce beau pays; j'aurais désiré pouvoir prendre congé de mes amis, de mes bons amis des environs de Villa-Rica; cependant je sens bien en même temps que si je faisais ce voyage, il me serait difficile de pouvoir m'embarquer cette année, et si j'attends peu de satisfaction de mon retour en France, je ne puis me dissimuler qu'une foule de devoirs m'y rappellent. Après bien des combats et des hésitations, je me suis enfin à peu près résigné à me diriger directement de Barbacena à Saint-Paul.

In after years SAINT-HILAIRE was again to recall the "beau ciel du Brésil." Thus he wrote in a preface to one of his "Voyages" (part 3, vol. 1, p. v):

> "Lorsque j'ai commencé à me rétablir de la longue maladie à laquelle je viens d'échapper encore, je me suis mis à rédiger la relation de mon voyage à Goyaz. J'écartais l'idée du présent, si douloureux pour moi, en me transportant en imagination sous le beau ciel du Brésil, et à une epoque où avide de savoir, je parcourais les déserts de cette vaste contrée, à peu près aussi peu soucieux de l'avenir que les Indiens eux-mêmes."

Often referred to in Brazil as "Brazilian at heart," SAINT-HILAIRE is beloved to this day in that country, where particular attention has been paid him. On October 6, 1928, the Brazilian historian TOBIAS MONTEIRO, in presenting the "Museu Nacional" of Rio de Janeiro with a bronze bust by SEYSSÉS of the French naturalist, delivered an address consisting of a biography of SAINT-HILAIRE. A bio-bibliography of the savant was also

presented by A. J. DE SAMPAIO and subsequently published. (Bol. Mus. Nac. 4:1-33.) MONTEIRO's oration was reproduced in the "Almanak Agrícola Brasileiro" (18:186-192, 1929) as a continuation of its series of biographies of great figures who have honored humanity in general and in particular the Brazilian nation, especially in the field of Science and Agriculture. The editors of the "Almanak" regarded MONTEIRO's biography of SAINT-HILAIRE as the most valuable account of his life, giving a clear and picturesque view of his travels, works, and above all, his great love for Brazil.

On June 25, 1935, at Rio de Janeiro, in the "Jardim Botânico" homage was again paid to SAINT-HILAIRE as well as to the "Muséum d'Histoire Naturelle de Paris," with the dedication of another monument to the naturalist (Rodriguésia 1: 117-119, 1935; *cf.* Rodriguésia 5, No. 14, 1941, frontispiece, for an illustration of the bust). We are indebted to Dr. A. A. BITANCOURT of the Instituto Biológico, São Paulo, Brazil, for examining this bust, and comparing it with the bust by SEYSSÉS as portrayed in the Almanak (*loc. cit.*). Dr. BITANCOURT found that the bust in the Jardim Botânico, which is by H. Cozzo, 1934, represents SAINT-HILAIRE at an appreciably later age than the SEYSSÉS bust.

In MORAES' historical preface accompanying his translation "AUGUSTE DE SAINT-HILAIRE, Viagem à provincia de São Paulo . . ." (*loc. cit.*), he states that the first half of the 19th century was the golden epoch of scientific discovery in Brazil. Until then, he wrote, almost nothing was known of the flora, fauna, and the physical geography of this vast country. With this introduction he describes in detail the background for presence of the young botanist SAINT-HILAIRE as a member of the French embassy to accompany the Duke of Luxembourg to Rio in 1816.

PENA initiated his "Galeria bibliografia dos botânicos brasileiros e dos estrangeiros que visitaram o Brasil" (Rodriguésia 5, No. 14: 375-378, 1941) with a biographical account of SAINT-HILAIRE followed by a list of his publications. He stated that among naturalists who have visited Brazil, the French savant may be considered the greatest friend of the country, the best observer, and the kindest at heart. He referred to the difficulties of travel in the interior of Brazil during the period of SAINT-HILAIRE's visit, now over 12 decades ago, and to the great value of his observations covering a broad scientific field. All of SAINT-HILAIRE's publications are rare today, especially in Brazil, PENA wrote; however, as he showed, most of the travel volumes have now been translated into Portuguese. Thus has been answered MONTEIRO's lament (*cf.* "Almanak," *loc. cit.*, p. 191) that these French texts describing Brazil at the beginning of the 19th century with such clarity had not been translated into the language of the country.

This first reprinting of SAINT-HILAIRE's "Esquisse des voyages de l'auteur . . .", in Chronica Botanica, may be regarded as another international tribute to SAINT-HILAIRE, the first from North America.

For the sketch on the title page, referred to on p. 18, we are indebted to B. Y. MORRISON, who adapted it from an illustration in "AUGUSTE DE SAINT-HILAIRE, Viagens na comarca de Curitiba em 1820," translated by D. CARNEIRO, with the addition of pertinent illustrations (Curitiba, 1938).

HISTOIRE
DES PLANTES
LES PLUS REMARQUABLES
DU BRÉSIL ET DU PARAGUAY;

COMPRENANT LEUR DESCRIPTION,
ET DES DISSERTATIONS SUR LEURS RAPPORTS, LEURS USAGES, etc.,

AVEC DES PLANCHES, EN PARTIE COLORIÉES.

PAR M. AUGUSTE DE SAINT-HILAIRE,
CORRESPONDANT DE L'ACADÉMIE DES SCIENCES, MEMBRE DE PLUSIEURS SOCIÉTÉS SAVANTES.

Dédiée à Sa Majesté Très-Fidèle.

TOME PREMIER.

A PARIS,
CHEZ A. BELIN, IMPRIMEUR-LIBRAIRE,
RUE DES MATHURINS SAINT-JACQUES, N°. 14.
1824.

FIGURE 5. — Frontispiece of the "Histoire des Plantes les plus remarquables . . . from which the following "Introduction" has been reprinted *verbatim* and *literatim*.

INTRODUCTION.

ESQUISSE DES VOYAGES DE L'AUTEUR, CONSIDÉRÉS PRINCIPALEMENT SOUS LE RAPPORT DE LA BOTANIQUE.

[p. i] Me proposant de décrire, dans cet ouvrage, les plantes les plus remarquables du Brésil et du Paraguay, je crois qu'il ne sera pas inutile de faire précéder leur histoire d'un aperçu de mes voyages dans ces vastes contrées, et de présenter un tableau rapide de leur végétation.

Je partis de France, le 1er. avril 1816, à bord de la frégate l'*Hermione*, qui portoit à Rio-de-Janeiro M. le duc de Luxembourg, ambassadeur de France.

Les trois relâches que nous fîmes à Lisbonne, Madère et Ténériffe, furent malheureusement trop courtes pour me permettre beaucoup de recherches; mais elles me procurèrent l'occasion d'observer la différence que le changement de latitude apporte dans l'époque du développement des mêmes végétaux. Ainsi nous laissâmes à Brest les pêchers sans feuilles et sans fleurs; le 8 avril ceux de Lisbonne étoient entièrement fleuris, et il en étoit de même du *Cercis,* de plusieurs espèces de *Lathyrus,* de *Vicia,* d'*Ophris,* de *Juncus,* etc.; le 25, à Madère, nous trouvâmes les pêches déjà nouées et le froment en épis; le 29, à Ténériffe, on faisoit la moisson, et les pêches avoient presque atteint une maturité parfaite.

Je passai à Rio-de-Janeiro tout le temps qu'y resta M. l'ambassadeur, et j'en parcourus soigneusement les alentours. L'extrême humidité qui règne dans cette partie du Brésil y entretient la végétation dans une activité continuelle; durant toutes les saisons, on trouve des plantes en fleur; l'été et l'hiver s'y distinguent à peine [p. ij] par une légère différence de teinte dans la verdure des forêts; et si l'on excepte les montagnes élevées de la province de Minas-Geraes, je crois que le district de Rio-de-Janeiro est le pays de tout le Brésil méridional qui, sur une même étendue de terrain, présente la Flore la plus variée.

Je préludai à mes voyages par une excursion sur les bords du Parahyba, à environ 25 ou 30 lieues de Rio-de-Janeiro, et je passai un mois dans la magnifique habitation d'Uba, au milieu des bois vierges (1).

Accoutumé à la fatigante monotonie de nos forêts de pins, de hêtres ou de chênes, l'Européen ne sauroit se former qu'une idée imparfaite des

(1) Cette habitation appartient à mon ami M. le commandeur Joaô Rodrigues Pereira de Almeida, qui m'a procuré des recommandations pour toutes les parties de l'Amérique que j'ai visitées, et sans lequel je me plais à reconnoître qu'il m'eût été impossible d'achever mes voyages.

bois vierges de l'Amérique méridionale, où la nature semble avoir épuisé ses forces pour étaler ce qu'elle a de plus magnifique et de plus varié. Là des arbres qui appartiennent à une foule de familles différentes se pressent et confondent leur feuillage; les *Mimoses* naissent à côté des *Cecropia;* les *Lecythis* et les *Vochisiées* près des *Palmiers* et des fougères en arbre. Des plantes parasites aux fleurs brillantes, telles que les *Orchidées* et les *Tillandsia,* revêtent les troncs desséchés d'une parure étrangère, et supportent elles-mêmes d'autres plantes parasites. Les tiges des bambous, entourées par intervalle de verticilles feuillés, s'élèvent à une hauteur prodigieuse et se courbent en berceaux élégans. Non moins variées que les grands végétaux, les lianes, tantôt comme les racines de certaines *Aroïdes,* tombent parfaitement droites de la cîme des arbres les plus élevés, et tantôt comme les *Bignonia,* les *Cissus,* les *Hipocratea,* se tordent à la manière des cables, pendent en festons, décrivent des ondulations gracieuses, s'élancent d'un arbre à l'autre, les serrent, les enlacent et forment des masses de [p. iij] feuilles et de branches où l'on a peine à démêler ce qui appartient à chaque végétal. Il faut avouer cependant qu'on voit dans les bois vierges beaucoup moins de fleurs que dans les pays découverts, et cela ne sauroit étonner, puisque la floraison met, comme l'on sait, un terme à la végétation, et que celle-ci sans cesse excitée dans les forêts de l'Amerique méridionale par ses deux agens principaux, la chaleur et l'humidité, doit nécessairement y conserver une activité continuelle.

Les forêts qui s'étendent à une petite distance d'Uba, vers le Rio-Bonito, servent d'asile à quelques centaines de ces Indiens que les Portuguais appellent *Coroados,* nom sous lequel ils confondent les foibles restes de différentes peuplades. L'ensemble des mêmes traits se retrouve chez toutes les nations américaines, mais chacune se distingue par des nuances de physionomie aussi faciles à reconnoître que celles qui caractérisent les peuples de l'Europe. Les Coroados du Rio-Bonito sont les plus laids et les plus désagréables peut-être de tous les Indiens que j'ai rencontrés dans mes voyages. Leur peau est d'un bistre terne et fort obscur; ils sont en général petits; leur énorme tête, aplatie au sommet, est enfoncée dans leurs épaules, et leur physionomie a quelque chose d'ignoble que je n'ai jamais vu chez les autres indigènes. Ils sont tout à la fois nonchalans, tristes, indifférens et stupides. A peine regardent-ils celui qui les caresse ou leur fait des présens. Tantôt ils montrent une sorte de timidité niaise, et, quand on leur parle, ils baissent la tête comme des enfans; tantôt ils poussent de grands éclats de rire dont il est impossible de deviner la cause. Ces Indiens errent dans les bois à 30 lieues de la capitale sans conserver d'habitations fixes, souvent dévorés par des maladies honteuses, à la merci des mulâtres et des hommes d'une classe inférieure parmi lesquels ils vivent; et personne ne songe à leur donner quelques idées de morale, et à les élever à ce foible degré de civilisation dont ils seroient susceptibles.

[p. iv] J'avois eu le chagrin de voir M. Delalande (1), mon compagnon de

(1) Avant son voyage au Brésil, M. Delalande en avoit déjà fait deux autres pour enrichir le Muséum d'histoire naturelle; et, après être revenu d'Amérique, il alla former des collections au cap de Bonne-Espérance. Tant de fatigues et de travaux avoient altéré sa santé; les chagrins, qui trop souvent attendent le naturaliste voyageur à son retour dans sa patrie, vinrent augmenter ses maux, et il fut enlevé à ses amis dans l'été de 1823.

voyage, s'embarquer pour l'Europe; ce naturaliste infatigable pouvoit difficilement être remplacé; mais voulant rendre son départ du Brésil moins sensible aux zoologistes, je commençai, pendant mon séjour à Uba, à réunir des insectes, des oiseaux, de petits quadrupèdes; et, jusqu'à mon retour en France, j'ai consacré au soin de former des collections d'animaux tout le temps qu'il m'étoit possible de dérober à mes observations botaniques; trop contrarié malheureusement par l'embarras des transports, l'extrême humidité et par une foule de difficultés dont le détail passeroit les bornes de cette Introduction.

Je partis de Rio-de-Janeiro, le 7 décembre 1816, pour me rendre dans la capitainerie des Mines, et j'employai quinze mois à parcourir une grande partie de cette vaste province.

Je crois que, pour faire mieux comprendre mes récits, il ne sera pas inutile de donner ici une idée générale des pays que j'ai visités. Les provinces maritimes du Saint-Esprit, Rio-de-Janeiro, Saint-Paul et Sainte-Catherine, sont bordées, du côté de la mer, par une chaîne de montagnes qui commence dans le nord du Brésil, laisse peu d'intervalle entre elle et le rivage, et qui, s'étant avancée jusques dans la province de Rio-Grande-do-Sul, décrit une courbure, se retire vers l'ouest et va finir dans la province des Missions. Une autre chaîne, à peu près parallèle à la première, mais plus élevée (1), s'étend vers le nord-est de la province de Saint-Paul, traverse toute celle des Mines, la sépare en deux parties très-inégales, divise les [p. v] eaux du Rio-Doce et du Rio-de-Saint-Francisco, et va se perdre dans le nord du Brésil. L'espace compris entre les deux chaînes est coupé par d'autres montagnes, qui, assez généralement, se dirigent de l'est à l'ouest, et laissent entre elles de profondes vallées. Si l'on excepte certaines parties moins inégales, situées dans la province de Saint-Paul et le district de Minas-Novas, le pays qui s'étend à peu près depuis la mer jusqu'à la cordillière occidentale, est entièrement couvert de forêts, ou le fut jadis, avant que la main des hommes les eût détruites. A l'ouest de la chaîne occidentale tout change d'aspect; aux montagnes succèdent des collines arrondies; de vastes pâturages s'offrent aux yeux du voyageur, et, avec une végétation différente, paroissent d'autres oiseaux et de nouveaux insectes. Si pourtant, au milieu d'un terrain découvert et simplement ondulé, il se trouve une vallée humide et profonde, s'il existe quelque enfoncement sur le penchant d'un morne, on peut être assuré d'y trouver un de ces bouquets de bois que les habitans appellent *capoês,* où ils forment leurs plantations, et qui diffèrent singulièrement des forêts vierges. Cependant le terrain s'abaisse jusqu'au Rio-de-Saint-Francisco, et la végétation éprouve des changemens que je ferai connaître à mesure que j'indiquerai les contrées que j'ai parcourues. A l'ouest du Rio-de-Saint-Francisco, le sol s'élève pour la seconde fois, et l'on arrive peu à peu à un plateau qui divise les eaux de ce grand fleuve et celles du Parana. Quelques points de ce plateau (2) présentent de véritables montagnes, telles que la Serra-da-Canastra et la Serra-dos-Pyreneos; mais d'ailleurs il est généralement trop égal pour pouvoir porter le nom de chaîne.

Lorsqu'on se rend dans la province des Mines par la grande route de Rio-de-Janeiro à Villa-Rica, on trouve, dans une largeur de plus de 50 lieues,

(1) *Serra do espinhaço* Eschw.
(2) *Serra dos vertentes* Eschw.

des montagnes souvent escarpées, des vallées profondes, et toujours des bois vierges; ceux-ci ne présentent pas de différences extrêmement sensibles; cependant comme le terrain [p. vj] s'élève graduellement, et que l'humidité diminue à peu près dans la même proportion, la végétation devient aussi peu à peu moins riche et moins variée.

A quelques lieues de l'endroit appelé Mantiqueira, près de la ville de Barbacena (1), on a déjà passé la chaîne occidentale (2), et c'est alors qu'on se trouve presque tout à coup dans ces pâturages immenses que l'on appelle *campos*. Ils se composent de *Graminées* entremêlées d'herbes, de sous-arbrisseaux et quelquefois d'arbrisseaux peu élevés; on y trouve en abondance des *Composées* et surtout des *Vernonies;* les *Myrthées,* les *Mélastomées* à fruits capsulaires y sont fort communes; mais on n'y revoit plus d'*Acanthées,* famille si nombreuse dans les bois vierges.

Les pâturages que je viens de décrire se retrouvent dans tous les pays élevés et peu montueux du midi de la province des Mines; ils forment une portion très-considérable de la Comarca (3) du Rio-das-Mortes, et c'est là que naissent presque tous les bestiaux qui servent à la nourriture des habitans de Rio-de-Janeiro.

Tandis que les sites de Rio-de-Janeiro épuisent, par leur pompe et leur diversité, l'admiration du voyageur, les environs de Villa-Rica, capitale de la province des Mines, attristent ses regards par leur aspect âpre et sauvage. Il ne découvre de tous côtés que des gorges profondes et des montagnes arides. Partout des terrains sillonnés, déchirés, bouleversés en tout sens attestent les travaux des mineurs; les antiques forêts ont été incendiées; la verdure des gazons a fait place à des amas de cailloux, et les rivières, souillées par l'opération du lavage, roulent des eaux rougeâtres et fangeuses.

Sans aucune connoissance en hydraulique, les habitans de la province de Minas-Geraes ont cependant une rare intelligence [p. vij] pour amener les eaux où elles leur sont nécessaires. D'ailleurs l'art du mineur est chez eux dans l'enfance; c'est dans des gamelles qu'ils font transporter la terre où l'or se trouve mêlé; ils laissent échapper beaucoup de parcelles d'or dans le travail du lavage; souvent pour arriver à un filon qui se trouve à la base d'une montagne, ils la coupent dans toute sa hauteur, et beaucoup d'esclaves périssent ensevelis sous des terres éboulées.

Les montagnes élevées des environs de Villa-Rica, qui font partie de la grande chaîne occidentale, sont généralement découvertes, du moins à leur sommet; elles offrent un nombre de végétaux infiniment plus considérable que les *campos* de la Comarca du Rio-das-Mortes, et sans doute il se passeroit bien des années avant qu'on eût entièrement épuisé la Flore des Serras d'Itacolumi (4), de Caraça (5), de Deos-Livre, etc. Là croissent prin-

(1) Et non Barbazenas ou Barbasinas, comme on l'a écrit.

(2) La chaîne occidentale porte dans une partie considérable de sa longueur le nom de *Serra da Mantiqueira* qu'elle emprunte de ce lieu.

(3) La province de Minas-Geraes est divisée en quartre *Comarcas.*

(4) Ce nom vient de deux mots indiens *ita,* pierre, et *cunumi,* enfant. J'écris *Itacolumi,* comme l'a fait l'abbé Casal, parce que cette dernière orthographe est conforme à la prononciation actuelle; et c'est à tort, ce me semble, qu'un savant historien reproche à l'auteur du *Corografia Brasilica* de s'être écarté des étymologies dans la manière dont il écrit le nom des lieux. On doit sans doute, autant qu'on peut, rappeler les étymologies; mais il faut, si je ne me trompe, que le voyageur et le géographe écrivent les noms des pays dont ils donnent la descrip-

cipalement une foule de *Mélastomées* à petites feuilles, quelques jolis *Sauvagesia,* beaucoup d'*Eriocaulon,* de *Xiris,* des *Luxemburgia,* un grand nombre de *Composées,* d'*Apocinées,* etc. Parmi les plantes qui caractérisent les hautes montagnes de la province des Mines, je ne puis m'empêcher de citer encore les *Vellozia* (Vandelli) (6), genre de la famille des *Amarillidées:* [p. viij] chez plusieurs de ses espèces qui vivent en société, des rameaux étalés, courts, épais, chargés d'écailles (7), forment un arbrisseau rabougri fort remarquable par son port; ces rameaux se terminent par une touffe de feuilles graminées, et du milieu d'entre elles naissent des fleurs bleues, violettes, quelquefois blanches, aussi grandes que nos lys.

Le fer, si commun dans la partie orientale de la province des Mines, y est indiqué par plusieurs plantes particulières, et, entre elles, on doit remarquer les trois *rubiacées* à tige arborescente et grêle, à feuilles dures, à fleurs odorantes, que les habitans confondent sous le nom de *quina da serra* ou *de Remijo,* et qu'ils emploient au même usage que le quina du Pérou (8).

Le pays qui s'étend de Villa-Rica à Villa-do-Principe offroit naguère des bois immenses, dont une portion considérable a été remplacée par des pâturages. Lorsque, dans cette contrée, on coupe une forêt vierge et qu'on y met le feu, il succède aux végétaux gigantesques qui la composoient, un bois formé d'espèces entièrement différentes et beaucoup moins vigoureuses; si l'on brûle plusieurs fois ce bois nouveaux (9) pour faire quelques plantations au milieu de leurs cendres, comme on a fait d'abord dans celles des bois vierges (10), bientôt on y voit naître une grande fougère qui ressemble singulièrement au *Pteris aquilina* (11) ; au bout de très-peu de temps enfin, les arbres et les arbrisseaux ont disparu, et le terrain se trouve entièrement occupé par une graminée grisâtre, velue et uniflore, [p. ix] qui souffre à peine quelques plantes communes au milieu de ses tiges serrées, et qu'on appelle *capim melado* ou *capim gordura* (12), parce qu'elle transsude un suc abondant et visqueux. Plusieurs habitans désignent avec raison, sous le nom de *campos artificiaes,* les pâturages dont je viens d'indiquer l'origine, et ils les distinguent ainsi de ceux du Rio-das-Mortes, qu'ils appellent par opposition *campos naturaes.*

Pour achever ici l'histoire des alternemens singuliers auxquels donnent lieu la coupe et l'incendie des forêts vierges, je dois dire que si on passe

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tion, tels que les habitans eux-mêmes les prononcent et les écrivent. Sans cela la géographie finiroit par devenir une science inintelligible.

(5) Des mots indiens *cara* et *haça,* ou *caa raçapaba,* ou même simplement *caraça,* défilé.

(6) *Radia,* Ach. Rich. Le nom de Vandelli doit être préféré parce qu'il est plus ancien et qu'il rappelle deux botanistes brasiliens fort distingués. Le *Vellosia* est voisin du *Xerophyta.*

(7) Ces écailles ne sont autre chose que la base des anciennes feuilles.

(8) Je les ai décrites dans mon livre des *Plantes usuelles des Brasiliens,* n°. II, sous les noms de *Cinchona ferruginea, Vellozii, Remijiana.*

(9) Ce sont eux qu'on appelle *capueiras.*

(10) Tel est le système détestable d'agriculture adopté par les Brasiliens des provinces de Rio-de-Janeiro, Minas-Geraes, Goyaz, etc., où l'on ne fait usage ni de charrue ni de fumier.

(11) C'est le *Pteris caudata.*

(12) Souvent le *capin gordura* remplace immédiatement *les capueiras,* ou même se montre au milieu d'elles après que les bois vierges ont été coupés. C'est cette graminée qui a été décrite par M. Nees sous le nom de *Tristegis glutinosa.*

dix-huit à vingt ans environ sans couper les bois qui leur succèdent, et qu'en même temps les bestiaux ne s'y introduisent point, on voit disparoître peu à peu les végétaux qui composoient ces derniers, les espèces primitives se montrent de nouveau (1) et il finit par se former un bois que l'on a peine à distinguer des véritables forêts vierges.

L'or abondoit autrefois dans les environs de Villa-Rica; ce pays fut riche et florissant, et l'on y bâtit un grande nombre de jolis villages; mais le métal, auquel la province des Mines doit sa population, est devenu rare, ou difficile à extraire; les esclaves sont morts, et, faute de capitaux, ils n'ont pu être remplacés; les Mineurs, en bouleversant de vastes terrains, les avoient enlevés à l'agriculture, et, ne voulant faire usage ni de la charrue ni des engrais, ils ne peuvent tirer parti de leurs champs de *capim gordura* (2); ils sont donc obligés de s'éloigner de leurs premières demeures; ils se répandent sur les frontières de leur vaste pays, y [p. x] détruisent d'autres forêts, et envient aux tribus errantes des Botocudos (3) les retraites qui leur restent encore.

Je fus retenu à Villa-do-Principe par une maladie assez grave, suite des fatigues que j'avois éprouvées. Au bout d'un mois je me remis en route; mais au lieu de continuer à me diriger vers le nord, je m'enfonçai dans les forêts épaisses qui couvrent la partie orientale de la province des Mines, et j'arrivai à Passanha, où l'on a placé un des détachemens chargés de protéger les frontières de la province contre les invasions des sauvages (4).

Depuis Uba, je n'avois vu aucun Indien, mais je trouvai à Passanha les restes de plusieurs peuplades indigènes, qui se sont rapprochés des Portugais par la crainte des Botocudos, ennemis de toutes les autres nations indiennes.

Le froment réussit très-bien dans les forêts de Passanha, et rend communément quarante pour un.

Comme au-delà de ce lieu l'on ne trouve plus que des forêts impénétrables, habitées par des Botocudos en guerre avec les Portugais, je fus obligé de revenir sur mes pas; mais bientôt je me dirigeai vers le district de Minas-Novas, qui a fourni à l'Europe tant d'améthystes, de chrysolithes, de topazes blanches, et d'aigues marines.

Les larges plateaux, si communs dans ce district, offrent des espèces de forêts naines composées d'arbustes de trois à cinq pieds, rapprochés les uns des autres, et qui, suivant les localités, diffèrent singulièrement entre eux pour les genres et les espèces. La [p. xj] plante qu'on trouve le plus généralement parmi eux est une *Mimose* épineuse dont le feuillage délicat est d'une élégance extrême, dont les fleurs sont disposées en épis grêles, et dont le port rappelle quelquefois notre *Genêt anglican* (5). Hors du dis-

(1) Les bois portent dans cet état le nom de *capueiras*.

(2) Le *capim gordura* engraisse les chevaux et les bestiaux, mais leur donne peu de vigueur.

(3) Ce mot est d'origine portugaise, comme M. le prince de Neuwied l'a très-bien fait observer. Il ne faut point écrire Botecudis, ainsi que l'ont fait quelques voyageurs.

(4) Ces détachemens, composés d'un très-petit nombre de soldats, sont placés sur sept points différens, et portent, assez mal à propos, le nom pompeux de *divisions*. Leur formation date du ministère du comte de Linharès.

(5) Mimosa dumetorum N. *Caule parcè aculeato; ramis sulcatis pubescentibus; foliis 2-pinnatis, partialibus multijugis; foliolis minutis, lineari-ellipticis, subtùs glanduloso-punctatis; spicis axillaribus,. geminis, gracilibus; corollâ profundè* 5-*fidâ; stam.* 10 *liberis; ovario villoso.*

trict de Minas-Novas, j'ai rarement retrouvé les bois nains que je viens de décrire; on leur donne le nom de *carascos*.

Après avoir traversé, par des chemins extrêmement difficiles, un pays désert, qui souvent est le théâtre des incursions des Botocudos, j'arrivai au lieu appelé Alto-dos-Bois (1) où est situé le village des Maconis.

Dans presque toute la longueur du Brésil, les Indiens de la côte parlent divers dialectes de la langue appelée par les jésuites *lingoa geral* (2), à laquelle se rattache aussi l'idiôme Guarani en usage dans les Missions et tout le Paraguay proprement dit; mais, par une singularité fort remarquable, les langues des indigènes de l'intérieur, des Maconis, des Coroados, des Malalis, Monoxos, Machaculis ou Machacarès, Bororos, Coyapos, etc., ne ressemblent en rien à l'idiôme Guarani, et diffèrent presque également entre elles.

Quand j'arrivai à Villa-do-Fanado, capitale du district de Minas-Novas (3), on étoit au mois de mai; alors je ne trouvois plus de [p. xij] coléoptères, et les fleurs devenoient chaque jour plus rares. A Rio-de-Janeiro, la pluie tombe indifféremment dans tous les mois de l'année; mais il n'en est pas de même des provinces de Minas, de Goyaz, et d'une partie de celle de Saint-Paul; les pluies, qui, dans ces contrées, commencent en février, durent jusqu'au mois de mars; et pendant les mois qui suivent, la terre n'est rafraîchie presque jamais que par les rosées des nuits.

Au-delà de Villa-do-Fanado, le terrain s'abaisse et devient égal; la végétation change encore une fois, et l'on trouve des bois qui tiennent le milieu entre les forêts vierges et les *carascos*. Les *cattingas*, c'est ainsi qu'on les appelle, présentent ordinairement un épais fourré de broussailles, de plantes grimpantes et d'arbrisseaux au milieu desquels s'élèvent, comme des baliveaux, des arbres de moyenne grandeur. A la fin de la saison des pluies, les cattingas commencent à perdre leurs feuilles, et en juin elles en sont dépouillées; alors on n'y trouve plus d'insectes, et les oiseaux eux-mêmes se retirent pour la plupart sur le bord des rivières et dans le voisinage des habitations. Cependant, long-temps même avant le retour de l'été, les bourgeons de plusieurs espèces commencent à se développer, des *Bombacées* se couvrent de fleurs avant d'avoir des feuilles, et enfin, quand les pluies recommencent à tomber, les gazons renaissent, les arbres et les arbustes se revêtent d'une nouvelle parure, et les insectes reparaissent avec elles.

Ce qui prouve au reste que les cattingas doivent à la sécheresse la chûte de leurs feuilles, c'est qu'ils conservent leur verdure sur le bord des rivières et des fontaines, et souvent le voyageur qui traverse ces bois a tout à la fois sous les yeux l'image riante du printemps et celle de l'hiver.

Après avoir long-temps traversé des cattingas, je vis la végétation prendre tout-à-coup un aspect différent, et des forêts majesteuses, ornées de la plus belle verdure, succédèrent sans aucune transition à des bois

(1) La montagne des boeufs.

(2) Un moderne parle de cette langue comme si elle portoit encore au Brésil le nom de langue *tupi;* mais ce dernier mot est aujourd'hui entièrement inconnu aux Brasiliens, et dans la réalité il paroît n'avoir jamais été qu'un sobriquet injurieux donné aux Indiens de la côte par leurs ennemis de l'intérieur.

(3) Elle porte aussi le nom de Villa-do-Bom-Successo. Tocayes ou Tocaya, qu'on a indiqué comme la capitale de Minas-Novas, est un lieu imaginaire. Peut-être avoit-on en vue l'habitation de Tocaios.

dépouillés de feuilles, qui souvent ressemblent beaucoup [p. xiij] à nos taillis de dix-huit ans. Le sol dans les cattingas offre un mélange de sable très-fin, et d'une terre végétale, noirâtre et friable: celui au contraire où je retrouvai des bois vierges est beaucoup moins sablonneux et plus substantiel. Telle est, je crois, la seule raison de la différence singulière que je viens de signaler.

Lorsque je me retrouvai dans des bois vierges, j'étois à environ 50 lieues de Villa-do-Fanado, près de Saint-Miguel-da-Jiquitinhonha (1). De nombreuses tribus de Botocudos errent dans les forêts voisines de ce hameau, et vivent avec les Portugais en bonne intelligence. Je passai quinze jours au milieu de ces Indiens, les plus vindicatifs, les plus imprévoyans sans doute des Brasiliens indigènes, mais aussi les plus gais, les plus communicatifs, les plus valeureux, et peut-être les plus spirituels; je m'appliquai à connoître cette nation singulière; et, quand je quittai les bords du Jiquitinhonha, je fus suivi par un jeune Botocudo qui, depuis, m'a constamment accompagné dans mes voyages, et que j'ai renvoyé dans sa patrie, avec tous les secours nécessaires, au moment où j'allois m'embarquer pour l'Europe (2).

Les Botocudos passent leur vie dans les bois, sans habitations fixes, sans aucune trace de culte, sans autre règle qu'un petit nombre d'usages que les pères transmettent à leurs enfans. Ils ne cultivent point la terre, et bornent leur industrie à façonner quelques poteries grossières, et à faire de petits sacs de filet, des arcs et des flèches. La chasse est leur unique occupation; mais celui qui tue une pièce de gibier l'abandonne à ses compagnons, et n'en mange [p. xiv] point sa part. Ils se barbouillent le corps de noir et de rouge; mais ils ne portent aucun vêtement, et si l'on donne à une femme un morceau d'étoffe, elle ne songe qu'à s'en couvrir la tête. Lorsqu'un enfant a atteint l'âge de huit à douze ans, on lui perce les oreilles et la lèvre inférieure; on passe un morceau de bambou dans le trou qu'on à formé, et bientôt on y substitue un disque d'un bois léger; peu à peu on donne à ces disques une dimension plus grande, et ils ont, chez les adultes, jusqu'à un pouce et demi à deux pouces de diamètre. Les Botocudos n'ont qu'une femme à la fois, mais ils admettent le divorce; et lorsqu'un des époux surprend l'autre en adultère, il a le droit de lui faire sur les bras de longues incisions; châtiment que le coupable reçoit sans murmurer. Lorsque ces Indiens sont émus par quelque passion, lorsqu'ils veulent exprimer le mécontentement et la reconnoissance, ils agitent leurs flèches; leur physionomie s'anime; ils cessent de parler; ils chantent, et mêlent à des inflexions

(1) On écrit aussi Giquitinhonha, mais jamais Jigitonhonha, comme l'a fait un voyageur moderne.

(2) Les lois publiées par le roi D. Joseph, sous le glorieux ministère du marquis de Pompal, ont proclamé la liberté des Indiens. Néanmoins, pendant le séjour de Jean VI à Rio-de-Janeiro, il a été rendu un décret qui accorde aux cultivateurs dix années de la vie de ceux des Botocudos qu'ils prendront chez eux pour les instruire. Ce décret, comme il étoit facile de le prévoir, a donné lieu aux plus horribles abus. Des mulâtres et même des blancs achètent pour des bagatelles des enfans à leurs pères, ou même ils les enlèvent par force, et les vendent ensuite dans les différens villages du district de Minas-Novas. Lorsque j'étois sur les bords du Jiquitinhonha, il n'y avoit déjà plus d'enfans dans les tribus (lotes) qui communiquoient le plus avec les Portugais, et pour pouvoir en vendre encore, ces tribus faisoient la guerre à d'autres plus reculées. Il est à espérer que l'on s'occupera en fin du sort des Indiens, et que l'on annullera le décret que j'ai rappelé plus haut.

monotones et nazillardes des éclats de voix effrayans. Plusieurs savans ont pensé que les Américains indigènes ne formoient point une race distincte; les Botocudos, souvent presque blancs, ressemblent, plus encore à la race mongole que les autres Indiens; quand le jeune homme de cette nation, qui m'a accompagné dans mes voyages, vit pour la première fois des Chinois à Rio-de-Janeiro, il les appela ses oncles, et le chant de ce dernier peuple n'est réellement que celui des Botocudos extrêmement radouci. L. S.

[p. xv] Je retournai à Villa-do-Fanado par un autre chemin, et je traversai différens villages du district de Minas-Novas, devenus riches depuis que leurs habitans ont renoncé à la recherche aventureuse de l'or et des pierreries, et qu'ils se sont livrés à la culture des cotonniers, plante qui réussit surtout dans les terrains légers où croissent les cattingas.

Sous le régime colonial, les Mineurs marchoient sur le fer, et il leur étoit défendu d'en fondre la plus légère parcelle; mais, après la translation de la cour de Lisbonne à Rio-de-Janeiro, on permit enfin aux habitans du Brésil de profiter des bienfaits que la nature leur a prodigués; le gouvernement lui-même établit des forges à ses frais, et une foule de propriétaires se mirent à fondre du fer pour l'usage de leur maison. Ce fut à Bom-Fim, près Arassuahy, dans le district de Minas-Novas, que je vis l'établissement de ce genre le plus important (1), et, après avoir eu trop souvent sous les yeux le spectacle affligeant de l'indolence et de l'apathie, j'éprouvai une véritable jouissance, en contemplant enfin celui de l'industrie et du travail.

Étant à Arassuahy, je me trouvois pour la seconde fois à peu de distance du District-des-Diamans; mais, avant de le visiter, je voulus parcourir la partie de la province des Mines qu'on appelle le Désert (*Certaô*). C'est un vaste pays ondulé et coupé de quelques montagnes, qui s'étend à l'ouest de la province, et sert de bassin au Rio-de-Saint-Francisco. Là des cattingas, à peu près semblables à celles de Minas-Novas, croissent dans les fonds; l'utile et majestueux palmier, appelé *buriti,* s'élève au milieu des marais; et les plateaux enfin sont couverts de pâturages parsemés de diverses espèces d'arbres tortueux et rabougris, dont l'écorce est subéreuse, les feuilles souvent dures et cassantes, et dont l'ensemble rappelle assez bien l'effet que produisent des pommiers plantés dans nos prairies.

[p. xvj] Si l'on fait abstraction des forêts vierges, on trouvera dans les diverses sortes de végétations particulières à la province des Mines une espèce d'échelle où les plantes diminuent de grandeur, à mesure que le terrain s'élève. Les cattingas croissent dans les parties les plus basses; au-dessus d'eux viennent les campos d'arbres rabougris; plus haut l'on trouve des carascos, qui ressemblent à nos jeunes taillis; les carascos, proprement dits, couronnent les grands plateaux; et enfin, sur les sommets les plus élevés, l'on ne trouve que des plantes herbacées entremêlées de sous-arbrisseaux. Tout le monde sentira au reste qu'une telle mesure ne sauroit être rigoureuse, et qu'il doit exister une foule d'exceptions déterminées par l'exposition, le plus ou moins d'humidité, et surtout par la nature du sol.

Parmi les animaux communs dans le Désert, on peut citer principalement l'oiseau appelé *seriema* (2), qui rivalise de légèreté avec les cerfs,

(1) Il a été formé par M. le capitaine Manoel Jose Alvez Pereira.
(2) Le *cariama* des naturalistes.

quadrupèdes dont les habitans de cette contrée distinguent cinq espèces différentes.

Le bétail et les chevaux forment la principale richesse du Certaô ou Désert, et les terres salpêtrées qui abondent dans ce pays remplacent, pour les bêtes à cornes, le sel qu'on est forcé de leur donner dans les autres parties de la province des Mines et dans celle de Saint-Paul, lorsque l'on ne veut pas voir ces animaux languir et périr en peu de temps.

Continuant mon voyage vers le nord-ouest, j'arrivai enfin au Rio-de-Saint-Francisco, magnifique rivière dont on ne parle qu'avec effroi dans le reste de la province des Mines, à cause des maladies qu'elle occasionne. Ses eaux, pendant la saison des pluies, grossissent, peu à peu, débordent et s'étendent jusqu'à une lieue de leur lit, et quelquefois davantage. A la fin de décembre, l'inondation est arrivée au point le plus élevé; mais peu à peu les eaux s'évaporent [p. xvij] et s'écoulent, et au mois d'avril la terre n'offre plus qu'un limon fangeux. L'air est bientôt corrompu par les matières animales et végétales en putréfaction; et c'est alors que commencent les maladies qui règnent tous les ans sur les bords du Rio-de-S.-Francisco; une fièvre ardente, précédée de frissons, attaque les habitans de cette contrée, et souvent elle laisse des obstructions qui conduisent au tombeau ceux qui ne sont point encore acclimatés et les individus d'un tempérament foible.

Les terrains inondés des bords du Rio-de-S.-Francisco (1) portent le nom de *lagadissos,* et sont couverts de deux légumineuses à épines, un *Bauhinia* à petites feuilles, et une *Mimose* odorante, qui forment des buissons impénétrables.

C'était au mois d'août et de septembre que je parcourois les déserts du Rio-de-S.-Francisco; je n'avais par conséquent rien à craindre des maladies; cependant ce voyage fut un des plus pénibles de ceux que j'ai faits dans le Brésil, et l'excessive sécheresse le rendit un des moins profitables pour l'histoire naturelle (2).

(1) Ceci suffit pour faire voir ce que l'on doit penser des descriptions brillantes que l'on a faites des bords du Rio-de-S.-Francisco. Il est certain que l'aspect de cette contrée doit être charmant dans la saison des pluies; mais il n'y règne point un printemps perpétuel, puisque la plupart des arbres perdent leurs feuilles pendant la sécheresse.

(2) Parmi les oiseaux que j'ai rapportés du Rio-de-S.-Francisco, je ne puis m'empêcher de citer le charmant troupiale appelé *soffrè* (*soffrer,* Casal. Cor. Bras., vol. 1, page 91). De toute la province des Mines, cet oiseau, qui appartient aux pays découverts, ne se trouve que dans le Certaô (désert) et à commencer à peu près vers la hauteur de Paracatù; mais de là il s'étend par l'intérieur jusque vers Bahia, et peut-être davantage du côté du nord. Il vole par petites troupes, se nourrit d'insectes, et, quoi qu'en dise Casal, il a un chant très-agréable. On le met quelquefois en cage pour le transporter à Villa-do-Principe et ailleurs; mais son plumage orangé blanchit peu à peu, et il ne vit guère plus d'un an loin de son pays natal. M. Valenciennes, naturaliste du Muséum, qui a classé les animaux vertébrés que j'ai déposés à cet établissement, et qui réunit à des vues philosophiques une connoissance profonde des espèces; M. Valenciennes, dis-je, caractérise le *soffrè* de la manière suivante: "Oriolus aurantius; *corpore aurantio, capite, jugulo, alis, caudâ et dorsis medium versus fasciâ, nigerrimis; maculâ alarum alba.*—Guira Tangeima Marcg. 192; *pro oriolo ictero a Gmelin acceptus.* —Or. ictero *multum affinis, sed differt,* 1°. *magnitudine minore;* 2°. *rostro abbreviato acutiore;* 3°. *colore florido aurantio;* 4°. *occipite aurantio et non nigro.*—Ab Or. Jacamaici *differt,* 1°. *magnitudine majore;* 2°. *cervice nigro nec aurantio;* 3°. *maculâ alarum majore et magis porrectâ.*" J'observerai qu'en admettant le *guira tangeima,*

[p. xviij] Le District-des-Diamans où j'entrai, après être sorti du Désert, peut avoir douze lieues portugaises de circonférence. Ce canton, le plus élevé peut-être de toute la capitainerie des Mines, ne présente guère que des terrains arides, des sables et des rochers nus au milieu desquels l'on trouve cependant un grand nombre de plantes rares et intéressantes. Un accident, dont je faillis être la victime, me retint pendant un mois à Tijuco, chef-lieu du district (1) ; je profitai de ce temps pour me procurer des renseignemens exacts sur l'administration singulière de ce pays, et, avant de le quitter, je visitai les différens points où l'on travaille encore au lavage des diamans. Cette pierre ne se trouve plus dans sa matrice primitive, mais seulement dans le lit des ruisseaux et sur leurs bords. Elle est aujourd'hui beaucoup moins abondante qu'elle n'étoit jadis; cependant, quoiqu'on n'emploie pas à son extraction à beaucoup près autant d'esclaves qu'autrefois, les dix années antérieures à 1818 ont présenté, pour les pierres extraites, un terme moyen de 18,000 karats.

[p. xix] Ne voulant pas retourner à Villa-Rica par les mêmes chemins, je suivis le sommet des montagnes très-élevées appelées Serra-da-Lapa, qui ne sont qu'une portion de la grande chaîne occidentale et qui divisent en partie les eaux du Rio-Doce et du S.-Francisco. Je ne puis m'empêcher de faire remarquer en passant que les poissons des rivières qui coulent à l'ouest de ces montagnes et se jettent dans le Rio de S.-Francisco, sont différens en général de ceux des rivières dont les eaux se dirigeant vers l'est, vont se réunir à celles du Rio-Doce.

J'eusse fait, dans la Serra-da-Lapa, la plus riche moisson de plantes, si les pluies qui tomboient depuis un mois ne m'eussent forcé de m'éloigner de ces montagnes, où les moindres ruisseaux devenoient des torrens.

Je recommençois alors à trouver des insectes; les végétaux offroient des fleurs et la plus belle verdure; mais il seroit difficile de donner une idée du temps qu'il faut perdre et des soins qu'il est nécessaire de prendre, lorsqu'on voyage dans ces contrées, pendant la saison des pluies, avec des collections que l'on veut conserver.

Avant de retourner à Villa-Rica, je passai par Sabarà, et dans les environs de cette ville, sur la montagne appelée Serra-da-Piedade, j'eus l'occasion d'observer une catalepsie extraordinaire qui avoit attiré l'attention de toute la province des Mines.

Sabarà est un des points de cette province où l'on a planté la vigne avec le plus de succès. Comme à Villa-Boa et ailleurs, elle y donne d'excellens fruits deux fois l'année, la première pendant la saison des pluies, et la seconde durant la sécheresse.

Après avoir revu Villa-Rica, je passai par la ville de S.-Joaô-del-Rey, et enfin j'arrivai à Rio-de-Janeiro au mois de mars 1818, plein de reconnoissance pour un peuple chez lequel j'avois trouvé l'hospitalité la plus aimable, que la nature a doué d'un caractère doux et communicatif, du senti-

Marcg., pour synonyme de l'*oriolus aurantius,* il faut supposer que le mot *uranicus* a été mis, par faute d'impression, pour *aurantius,* et avouer en même temps que l'expression de *clamare,* employée par Marcgraff, convient peu pour exprimer le chant du *soffrè.*

(1) Je passai ce temps dans la maison de l'Intendant des diamans, M. Manoel Ferreira da Camara Bethancurt e Sà, et je fus traité chez lui comme chez un père. Que cet administrateur, également recommandable par ses lumières et sa droiture, reçoive ici l'hommage de ma reconnoissance!

ment des arts, d'une rare intelli-[p. xx]gence, d'une facilité extraordinaire pour apprendre ce qu'on lui enseigne, et qui, s'il a quelques défauts, les doit pour la plupart, peut-être, au systême de gouvernement qui avoit précédé l'arrivée de Jean VI à Rio-de-Janeiro.

J'employai le peu de temps que je passai dans cette capitale à mettre de l'ordre dans mes notes et dans mes collections, et je fis au Muséum d'histoire naturelle de Paris l'envoi de quelques caisses d'oiseaux et de quadrupèdes. Ayant formé le projet d'adresser à l'Académie des sciences une *esquisse géographique de la végétation dans la capitainerie des Mines,* je me livrai à ce travail avec ardeur; mais le défaut de livres et d'objets de comparaison m'obligèrent bientôt à l'interrompre, et je dois m'en féliciter peut-être, puisque mes voyages subséquens me permettront d'étendre cette esquisse depuis les sources du Rio-dos-Tucantins jusqu'à l'embouchure du Rio-de-la-Plata. Je me bornai donc à faire passer à Messieurs les professeurs du Muséum un second *Mémoire sur les plantes dont le placenta devient libre après la fécondation,* et un autre sur la famille des *Vochisiées* (1) ; et, voulant prendre une idée de la côte qui s'étend au nord de Rio-de-Janeiro, je partis pour la province du Saint-Esprit et la Rio-Doce.

Le territoire que je parcourus avant d'arriver a ce fleuve est compris entre l'Océan et cette cordillière qui, se prolongeant parallèlement à la mer dans une partie considérable du Brésil, se rapproche plus ou moins du rivage. Une suite de lacs qu'on rencontre jusqu'à la ville de S.-Salvador-de-Campos, et dont plusieurs communiquent avec l'Océan, sembleroient prouver qu'à une époque, qui ne sauroit être extrêmement reculée, ses eaux s'étendoient jusqu'aux montagnes.

Si l'on excepte les endroits marécageux ou très-sablonneux, le [p. xxj] pays est aujourd'hui couvert de bois vierges, ou bien il offre les plantes qui les remplacent, quand ils ont été détruits par la main des hommes.

A quelques différences près, les espèces des environs de Rio-de-Janeiro se retrouvent fort loin sur la côte au nord de cette ville. Cependant j'observai une végétation nouvelle pour moi dans ces terrains voisins de la mer, qu'on appelle *restingas.* Des arbrisseaux, hauts de quatre à six pieds, et rameux dès la base, y croissent çà et là; ils se présentent en général sous la forme de buissons isolés, mais chaque espèce a un port et un feuillage qui lui sont propres; de petites lianes grimpent entre leurs branches; un *Loranthus* (2) s'épanche en quelque sorte sur les nombreuses *Myrtées,* et des *Cactus,* à rameaux nus et dressés, contrastent avec les masses de feuillages arrondies qui les entourent: on diroit un jardin anglais où l'on a disposé avec art les espèces d'arbustes qui se marient le mieux, ou qui produisent les oppositions les plus heureuses. Si le terrain est sec, on ne voit entre ces arbrisseaux qu'un sable pur; s'il est humide, il y croît des plantes basses, entre autres des *Scirpus,* des *Eriocaulon* et des *Xiris,* deux genres qui se plaisent ensemble, comme chez nous le *Linum radiola* et l'*Exacum filiforme;* enfin, l'humidité augmente-t-elle davantage, on marche sur des tapis charmans, parsemés d'une quantité de petites fleurs couleur

(1) Ils ont été insérés tous les deux dans les mémoires du Muséum d'Histoire naturelle.

(2) Loranthus rotundifolius N. *caulibus diffusis; foliis subrotundis glabris; floribus axillaribus, congestis, bracteatis, 6-andris; pedunculis brevibus plurifloris.* On emploie ses feuilles bouillies avec du lait et du sucre dans les maladies de poitrine.

de chair, qui sont celles d'une *Hedyotis* (1). C'est aussi au milieu du sable des *restingas* que croissent l'*Ionidium Ipecacuanha* et une variété assez singulière de cette espèce, variété dans laquelle la corolle est deux fois plus courte que le calice, et [p. xxij] où trois filets restent stériles (2). A l'exception de la Serra-de-Caraça et de celle de Penha, dans la province des Mines, la restinga, voisine de la Cité (3) du Cap-Frio, est peut-être, pour la botanique, le point le plus intéressant que j'eusse visité jusqu'alors.

Avant d'arriver à la Cité du Cap-Frio, je passai par le village de S.-Pedro, où vivent les seuls Indiens qui existent encore sur la côte entre Rio-de-Janeiro et S.-Salvador-de-Campos.

[p. xxiij] Au-delà de la Cité du Cap-Frio, j'allai visiter le cap qui porte le même nom, la première terre qu'aperçoivent les navigateurs sur la côte du Brésil lorsqu'ils se rendent d'Europe à Rio-de-Janeiro.

Dans le district de Goytacazes (4), les montagnes laissent une vaste plaine entre elles et l'Océan. C'est là que, de toute la province de Rio-de-Janeiro, on cultive le sucre avec le plus de succès. Les environs de la ville de Campos sont peut-être aussi animés que ceux de nos grandes villes de province, et en rappellent l'aspect. Peu de pays offrent un exemple d'une fertilité égale à celle des terres du district de Goytacazes; il en est qui, depuis cent ans, n'ont jamais cessé de produire, et pourtant on ne les fume point et elles ne sont arrosées par les eaux d'aucun fleuve (5). C'est dans ce canton seulement que j'ai trouvé quelque idée légère d'un système

(1) Ce genre paroît devoir être réuni non-seulement aux *Houstonia,* mais encore aux *Oldenlandia.*

(2) Ionidium Ipecacuanha var. *β. villosum; caule prostrato; foliis lanceolatis, acutis, argutè serratis; pedunculis axillaribus, solitariis, folio brevioribus, 2-bracteatis; corollâ calice duplò breviore, inclusâ glabrâ; filamentis* 3 *sterilibus. Obs.* La plante que j'appelle ici *Ionidium Ipecacuanha,* et qui se trouve avec l'*I. indecorum,* est certainement la même que le *Viola Itoubou* d'Aublet (Guy., 808, t. 318) et le *Viola calcearia* de Loefling (*it.,* 184); mais je lui donne le nom d'*Ipecacuanha* parce que ce nom est plus connu et plus significatif, et que je considère les *V. Ipecacuanha* et *calcearia* de Linné comme identiques. En effet, la plante de Barrère, rapportée comme synonyme du premier, est bien certainement l'*Itoubou* d'Aublet. Il ye a plus: Barrère, cite Pison, dont la courte phrase (Med. Bras., 101) indique certainement ma plante, et Pison ne pouvoit avoir qu'elle en vue, puisqu'il la nomme *Ipecacuanha branca* (*blanca* par faute d'impression), et que c'est bien mon espèce qu'on appelle *Ipecacuanha* ou *poaya branca* à Fernanbouc où Pison faisoit ses observations. Le *Pombalia* de Vandelli qui, soit dit en passant, auroit dû être adopté comme plus ancien à la place d'*Ionidium,* le *Pombalia,* dis-je, cité comme synonyme du *V. Ipecacuanha,* convient parfaitement à ma plante, avec cette différence qu'il n'est pas aussi velu; mais les échantillons que j'ai rapportés sont déjà moins velus que ceux qui viennent de la Guyane, et ceux-ci varient beaucoup pour la quantité de poils. M. le prince de Neuwied, qui a recueilli dans les mêmes lieux que moi la plante dont il s'agit ici, lui donne aussi le nom de *Viola Ipecacuanha* et la rapporte également au *Pombalia* de Vandelli. Quoi qu'il en soit au reste, les habitans du pays emploient avec un très-grand succès les racines de mes plantes dans les dyssenteries. On prétend aussi dans le nord du Brésil que l'*Ipecacuanha branca* guérit de la goutte.

(3) Le titre de cité (*cidade*) n'appartient en général qu'aux villes qui sont la résidence d'un évêque. Il fut donné, par exception, à celle du Cap-Frio, du temps de Philippe II, et elle l'a conservé depuis.

(4) Ce nom est celui d'une peuplade Indienne que les Portugais confondent aujourd'hui avec plusieurs autres sous la dénomination générique de *Coroados* (couronnés), empruntée de la manière dont ces indigènes coupent leurs cheveux.

(5) Il existe des terrains qui sont inondés chaque année par le Parahyba, mais ce ne sont point les plus fertiles.

régulier d'assolement. Quand la canne à sucre commence à ne plus produire, on la remplace par le manhioc, qui donne d'abord des récoltes abondantes, et, lorsque celles-ci commencent à n'être plus aussi bonnes, on replante immédiatement dans le même terrain la canne à sucre, qui pousse avec une nouvelle vigueur.

Tandis que, dans la province des Mines, j'avois été si souvent fatigué par la monotonie de l'aspect des campagnes, je jouissois souvent dans ce nouveau voyage des points de vue les plus variés et les plus pittoresques. Mais il s'en faut bien que, du moins jusqu'à Campos, j'aie retrouvé, chez les habitans de la côte, l'aimable hospitalité et l'intelligence peu commune des Mineurs. Le voisinage d'une capitale, telle que Rio-de-Janeiro, explique assez le peu d'hospitalité des pays environnans; plusieurs causes s'opposent au déve-[p. xxiv]loppement des facultés intellectuelles de ceux qui y vivent; j'indiquerai légèrement une d'entre elles: même dans la province des Mines, pays éloigné de la mer, j'avois déjà remarqué que l'intelligence des habitans étoit en rapport avec l'élévation du sol (1).

La province du Saint-Esprit commence à peu de distance de Campos, et se prolonge, vers le nord, jusqu'au-delà du Rio-Doce; mais, tandis que du côté de Matogrosso, la domination brasilienne s'avance jusqu'aux frontières des colonies espagnoles, ici les Portugais ne se sont guère étendus à plus de huit lieues du rivage. Plus loin sont des forêts immenses, habitées par des Indiens sauvages, qui quelquefois même font des incursions sur la côte, et la rendent dangereuse à parcourir (2). Les hommes de notre race, les nègres et les mulâtres racontent une multitude de faits pour prouver que ces Indiens sont anthropophages; mais, quand on connoît la haine de ceux qui portent contre eux cette accusation, peut-être est-il permis de conserver quelques doutes.

On voit dans la province du Saint-Esprit plusieurs villages, naguère peuplés et florissans, qui furent construits par des Indiens civilisés; aujourd'hui ils sont déserts, et tombent en ruines, et il n'est pas difficile de prévoir que, dans peu d'années, il ne restera [p. xxv] plus de leurs premiers habitans que des souvenirs historiques et quelques uns des noms qu'ils donnèrent aux lieux où ils vécurent.

Dans une grande partie du Brésil, les cultivateurs se plaignent avec raison du ravage des fourmis; mais peut-être en causent-elles plus que partout ailleurs aux environs de Benevente et de Villa-da-Victoria, capitale de la province du Saint-Esprit. Souvent, en une seule nuit, ces insectes dépouillent de leurs feuilles des groupes d'orangers, ou détruisent entièrement des plantations considérables de manhioc, et jusqu'à présent on n'a point encore trouvé de moyens efficaces pour éloigner ce fléau.

(1) En convenant que les hommes de la côte sont bient loin d'accueillir les étrangers comme ceux de l'intérieur, je dois dire aussi que l'on a beaucoup exagéré leur inhospitalité. Quant au reproche de férocité qu'on leur a fait encore, il est suffisamment réfuté par la modération qu'ils ont montrée généralement dans les révolutions dont leur pays a été le théâtre. Il seroit presque ridicule, je crois, de s'arrêter à démontrer la fausseté de ce qui a été écrit sur la prétendue dextérité avec laquelle les habitans de Rio-de-Janeiro lancent leur couteau contre ceux dont ils croient avoir reçu quelque injure.

(2) On n'est point parfaitement d'accord sur les peuplades auxquelles ces sauvages appartiennent. Je dirai ici par occasion que l'ancien nom de Tupinambas, qui se retrouve dans plusieurs ouvrages modernes, n'est plus aujourd'hui connu des Brasiliens.

Avant d'arriver à Villa-da-Victoria, je vis avec quelque étonnement un terrain dont la végétation avoit l'aspect des *carascos* de Minas-Novas. En général les plantes des *restingas* ont souvent une grande analogie avec celles des plateaux sablonneux de la capitainerie des Mines, et cela prouve que les changemens de terrain ne contribuent guère moins que l'élévation du sol aux différences que l'on observe dans la végétation de cette province.

Le Rio-Doce, qui fut le terme de ce voyage, prend sa source dans la province des Mines, et pourroit être de la plus grande utilité pour répandre le fer sur la côte du Brésil et faire parvenir dans l'intérieur le sel dont les bestiaux ne sauroient se passer. Mais divers obstacles s'opposent malheureusement à cette navigation. Plusieurs catadupes (cachoeiras) arrêtent les eaux du fleuve dans leur cours, et ses bords, extrêmement malsains, sont infestés par des tribus de Botocudos, ennemies des Portugais. Sous le système colonial, le gouvernement évitoit de former des liens entre les provinces; lors de l'arrivée du roi au Brésil, on dépensa des sommes considérables pour rendre le Rio-Doce navigable; mais leur emploi fut mal dirigé, et, lorsque je visitai ce fleuve, il étoit à peine fréquenté par quelques aventuriers mulâtres auxquels l'appât du gain fait braver les périls attachés à cette navigation (1).

[p. xxvj] Pour pouvoir visiter le village de Linharès et le magnifique lac de Juparanan (2), je passai cinq jours sur les bords du Rio-Doce, et, sur trois personnes que j'avois avec moi, j'emmenai deux malades. Les pluies qui tombent si abondamment dans la province des Mines, de novembre jusqu'en mars, font sortir le fleuve de son lit, et, dans les endroits bas, il se forme sous les grands arbres des bois vierges, des marres où pourrissent des feuilles et d'autres débris de végétaux. Les gaz qui s'en exhalent, altèrent l'air atmosphérique pendant la saison de la sécheresse, et lorsqu-ensuite la rivière déborde, elle emporte avec elle ces eaux croupies qui corrompent les siennes et les rendent dangereures à boire. Ainsi, tandis que les rives du Rio-de-S.-Francisco ne sont malsaines que dans une saison, celles du Rio-Doce le sont pendant toute l'année; cependant les fièvres qu'elles occasionnent sont un tribut qu'on ne paie ordinairement qu'une fois, et, presque toujours, elles cèdent sans peine à quelques vomitifs.

Lorsque je revins à Villa-da-Victoria, la saison des pluies avoit déjà commencé, et rendoit le voyage par terre beaucoup plus difficile. Pour retourner à Rio-de-Janeiro, il eût fallu passer par les mêmes chemins, et je me décidai à m'embarquer. Je profitai de quelques jours qui s'écoulèrent avant mon départ pour recueillir de nouveaux renseignemens sur la province du Saint-Esprit qui offre plusieurs ports (3), d'excellens bois de construction et de menuiserie, et qui seroit florissante, si elle eût été gouvernée par des hommes plus habiles, et qu'on eût établi [p. xxvij] quelques communications entre elle et la province des Mines (4).

(1) On a annoncé la formation d'une compagnie qui doit se proposer pour objet la navigation du Rio-Doce; mais il est à craindre qu'elle ait aussi peu de succès que celles du même genre qui jusqu'ici ont été formées au Brésil.

(2) Des mots indiens *ju* et *parana*, lac des épines. Les noms empruntés des Indiens sont significatifs.

(3) Cette partie du Brésil se trouve décrite avec exactitude dans les voyages de M. le prince Maximilien de Neuwied.

(4) Pendant le séjour du roi au Brésil, on a commencé un chemin qui doit aller des environs de Villa-da-Victoria jusqu'aux Mines; mais il est à croire que bien des années se passeront avant qu'il soit achevé.

Arrivé à Rio-de-Janeiro, après quatre jours de navigation, je fis, au Muséum de Paris, un nouvel envoi d'objets d'histoire naturelle; j'emballai avec la plus grande précaution ceux que je conservois au Brésil, et les laissai à M. le chargé des affaires de France (1), qui voulut bien les garder durant toute mon absence.

Pendant mes deux premiers voyages, j'avois eu soin de prendre, autant que me le permettoient mes foibles connoissances, des notes sur la statistique des pays que j'avois visités, sur l'état du commerce, celui de l'agriculture, les mœurs et les usages des habitans; et j'ai continué à travailler sur le même plan jusqu'au moment de mon départ pour l'Europe.

Je ne m'étois point contenté de recueillir des plantes; j'avois analysé sur le frais celles que j'avois récoltées, et m'étois attaché principalement aux espèces dont les habitans font quelque usage.

Dans une contrée où les médecins sont encore peu nombreux, chaque cultivateur cherche des remèdes dans les végétaux qui croissent autour de sa demeure, et si, parmi les plantes employées par les Brasiliens pour le soulagement de leurs maux, il en est quin'ont que des vertus imaginaires, il s'en trouve d'autres aussi auxquelles on ne peut refuser des propriétés efficaces. Le gouvernement portugais avoit eu l'idée de réunir toutes les espèces de végétaux dont les Brasiliens font usage, de les livrer à l'examen de quelques hommes instruits, et de faire faire la concordance de leurs noms [p. xxviij] vulgaires: ce projet fut oublié presque aussitôt que conçu. S'il eût été possible de le réaliser dans toute son étendue, ce ne pouvoit sans doute être la tâche d'un homme seul, livré à beaucoup d'autres occupations, et forcé d'entrer dans les moindres détails d'un voyage pénible. Cependant, durant tout le cours de mes excursions, je ne négligeai rien pour me mettre en état de tracer les premiers traits d'une *histoire des plantes usuelles des Brasiliens,* et leur donner ainsi une marque légère de ma reconnoissance (2).

Je partis de Rio-de-Janeiro pour la troisième fois, et commençai ce nouveau voyage le 26 janvier 1819.

Voulant éviter de rentrer dans la province des Mines par le chemin que j'avois déjà suivi, je me dirigeai directement vers S.-Joaô-del-Rey, et visitai sur la route la Serra-Negra, l'un des points du Brésil méridional où l'on trouve le plus grand nombre de plantes.

Lorsque, suivant la route de Villa-Rica, on passe des forêts dans les Campos, on peut, comme je l'ai déjà dit, pressentir, quelque temps auparavant, cette différence de végétation. Mais ici le changement s'opère sans aucune nuance intermédiaire: je sortois d'un chemin étroit, où souvent j'aurois pu toucher avec la main les arbres majestueux qui m'entouroient de tous côtés, et je ne pus me défendre d'une impression vive de surprise et d'admiration, lorsque tout-à-coup je découvris une immense étendue de mornes arrondis, couverts seulement d'une herbe grisâtre, et entre lesquels étoient dispersés çà et là des bouquets de bois d'un vert foncé (capoês).

La perte d'un serviteur, aussi utile que fidèle, me retint un mois à S.-Joaô-del-Rey. Isolé au milieu des hommes qui m'entouroient, [p. xxix] et dans lesquels il m'étoit impossible de placer ma confiance, je fus sur le

(1) M. Maller, pendant mon séjour au Brésil, m'a rendu tous les services qui ont dépendu de lui, et a sollicité avec empressement, du gouvernement portugais, les facilités qui m'étoient nécessaires.

(2) J'ai déjà commencé à publier ce travail et je ferai ce qui dépendra de moi pour le continuer.

point de revenir sur mes pas. Cependant je fis des efforts pour ranimer mon courage, et je me dirigeai vers la province de Goyaz, en traversant la partie occidentale de celle des Mines que je ne connoissois pas encore.

Les environs de S.-Joaô, et en général toute la Comarca du Rio-das-Mortes, fournissoient autrefois beaucoup d'or; mais on y a presque entièrement abandonné l'exploitation des mines pour se livrer à l'agriculture, et peut-être y entend-on mieux que dans toutes les autres parties du Brésil l'éducation des bestiaux, singulièrement favorisée dans ce pays par la bonté des pâturages.

Faisant un détour, je me rendis par des chemins peu fréquentés à la Serra-da-Canastra (1), et j'admirai la cascade magnifique, et trop peu connue, appelée Cachoeira-da-Casca-d'Anta, à laquelle le majestueux Rio-de-S.-Francisco doit son origine.

Araxa (2), le premier village que je trouvai après avoir quitté la Serra-da-Canastra, est remarquable par les eaux minérales sulfureuses que l'on trouve dans ses alentours. Ce n'est point à la guérison de leurs maladies que les habitans les emploient, mais elles remplacent, pour leurs bestiaux, le sel qui dans ce pays ne s'achète qu'à des prix très-élevés. Chaque mois, les cultivateurs amènent de dix lieues à la ronde leurs troupeaux à Araxa; ils les font entrer, le jour déterminé par le juge, dans l'enclos où les eaux ont leurs sources, ils les y laissent une nuit, et les en font sortir le lendemain. Tous les animaux ont un goût singulier pour ces eaux désagréables; on a tué dans leur voisinage tant de cerfs, de cochons sauvages et d'autres quadrupèdes, qu'il n'en paroît presque plus; mais j'y ai vu encore des nuées d'oiseaux, surtout de perroquets et de colombes.

[p. xxx] Déjà, à une douzaine de lieues vers l'ouest de S.-Joaô, j'avois commencé à apercevoir quelques portions de campos parsemées d'arbres tortueux et rabougris (*tabuleiros cobertos*), comme ceux que j'avois vus en 1817 dans mon voyage au N. O. de la province des Mines. Jusqu'à Paracatu (3), je retrouvai une alternative assez singulière de campos ainsi parsemés de petits arbres et d'autres campos entièrement découverts.

J'avois espéré que je ferois une riche moisson de plantes, en parcourant un plateau qui, à l'une de ses extrémités, donne naissance au Rio-dos-Tucantins, à l'autre, au Rio-de-S.-Francisco, et qui divise les eaux de ce fleuve et celles du Parana; mais je fus désagréablement trompé dans mon attente. La plupart des plantes que je voyois autour de moi étoient celles que j'avois déjà observées, il y avoit environ deux ans, près du Rio-de-S.-Francisco; et dans les arbres rabougris que j'apercevois sur les *tabuleiros cobertos,* je retrouvois à peu près toujours les mêmes *Légumineuses,* les mêmes *Malpighia,* des *Bignonées* à fleurs jaunes, les mêmes *Salicariées,* les mêmes *Apocinées,* des *Vochisiées,* entre autres le *Salvertia convallariæodora* (4), [p. xxxj] et enfin cette espèce connue sous le nom de *Quina-*

(1) *Montagne de la malle,* nom qu'elle doit à sa forme.

(2) On raconte dans le pays des fables sur l'étymologie de ce nom: peut-être vient-il des mots indiens *ara echa,* chose tournée vers le soleil.

(3) Des deux mots indiens *pira* et *catu,* bon poisson.

(4) Le mémoire où j'ai fait connoître cette plante et la famille des *Vochisiées* a été publié dans les Mémoires du Muséum, p. 253, vol. VI. Comme c'est en mon absence qu'il a été imprimé, il s'y est glissé une contracdiction que je dois m'empresser de faire disparoître. Il y est dit, en deux endroits différens, que l'étamine du *Salvertia convallariæodora* est alterne avec un des pétales, et, dans la description détaillée de cette

do-campo ou de *Mendanha,* dont l'écorce remplace avec un si grand succès le quina du Pérou, et que j'ai reconnu avec étonnement pour un *Strychnos* (1). D'ailleurs il étoit tombé fort peu de pluie pendant l'été; dès la fin d'avril, j'avois déjà eu à me plaindre de la sécheresse, et la récolte de plantes que je fis dans ce voyage, de Rio-de-Janeiro à Goyaz, et de Goyaz à S.-Paul, fut malheureusement peu abondante.

Paracatu placé, comme un Oasis, au milieu du désert, doit son existence aux mines situées dans son voisinage, et sa fondation encore récente à l'un de ces Paulistes entreprenans qui ont découvert une si grande partie du Brésil (2). Cette ville eut un moment de splendeur; alors on rassembloit sans peine une grande quantité d'or dans le Corrego-rico (3) et les ruisseaux voisins; mais on le prodiguoit à mesure qu'on le tiroit de la terre; on faisoit venir à grands frais les vins et les autres marchandises de l'Europe, à travers le désert; on eut des musiciens, et même un petit théâtre; l'on dépensoit des sommes énormes pour les fêtes d'église; et les nègres même, dans leurs réjouissances, répandoient de la poudre d'or sur la chevelure de leurs meilleures danseuses. Cependant les mines sont devenues peu à peu plus difficiles à exploiter; l'attachement et la reconnoissance avoient fait affranchir un grand nombre d'esclaves; les autres sont morts, et n'ont pu être remplacés; à peine compte-t-on aujourd'hui, à Paracatu, deux ou trois personnes qui s'occupent en grand de l'extraction de l'or, et la population de cette ville, singulièrement réduite, se compose actuellement en très-grande partie de nègres libres, dont la vie s'écoule languissamment dans l'oisiveté et l'indigence (4).

[p. xxxij] Au Brésil, comme en Europe, certaines plantes semblent s'attacher aux pas de l'homme; elles le suivent dans les lieux les plus écartés, et conservant des traces de sa présence, elles ont souvent servi à me faire retrouver, au milieu des déserts qui s'étendent au-delà de Paracatù, la place d'une chaumière détruite. Ce qu'il y a de fort remarquable, c'est que ces plantes sont pour la plupart étrangères au pays même, et qu'elles s'y sont introduites et multipliées avec notre espèce. Je peux citer, pour exemple, l'*Argemone Mexicana,* le *Phlomis nepetifolia,* la *Cucurbitacée* appelée vulgairement *Erva de S. caetano,* etc.

Jusqu'à Paracatù, j'avois à peu près trouvé les mêmes espèces d'oiseaux que j'avois déjà vus dans mon premier voyage des Mines. Plus loin je commençai à en rencontrer de nouvelles.

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espèce remarquable, que son étamine est opposée. C'est ce dernier caractère qui est véritable: l'étamine fertile est opposée à un pétale, et les rudimens à deux autres pétales, comme dans le *Vochisia.* Ainsi, des trois genres qui composent la famille des *Vochisiées,* le *Qualea* a seul son étamine placée un peu sur le côté de son pétale. Au poste le *S. convallariæodora* mérite si bien son nom, qu'ayant fait revenir dans un verre d'eau une fleur desséchée depuis six ans, et qui avoit été passée plusieurs fois à la vapeur du soufre, elle communiqua encore à l'eau une odeur très-forte de muguet.

(1) Aug. de S.-Hil. *Pl. us. Bras.* n°. 1.

(2) Jose Rodrigues Froe, dont la famille existe encore dans les Mines et à Saint-Paul.

(3) Le ruisseau riche.

(4) Tout ceci prouve que l'on a induit en erreur les écrivains qui ont avancé que les Brasiliens ne rendoient jamais la liberté à leurs esclaves. Les affranchissemens sont au contraire très-fréquens dans cette partie de l'Amérique, et l'on y trouve quelques villages presque uniquement peuplés de nègres et de mulâtres affranchis ou fils d'affranchis.

Continuant à traverser des pâturages, tantôt découverts et tantôt parsemés d'arbres rabougris, j'arrivai à Os-Arependidos, lieu qui sépare la province des Mines de cellè de Goyaz. On étoit alors à la fin de mai, et, ce qui prouve combien ces contrées lointaines entretiennent peu de communications, c'est que, jetant un coup d'œil sur les registres du commandant du poste, je vis que, depuis le 19 février, j'étois le premier voyageur qui eusse passé par cette route.

Les fleurs devenoient chaque jour plus rares, et, si j'en trouvois encore, c'étoit presque uniquement dans les *Quèmadas,* nom que l'on donne aux campos où le feu a été mis récemment. Pour procurer aux bestiaux une nourriture plus fraîche et plus tendre, les habitans des pays découverts de l'intérieur du Brésil ont coutume de brûler une partie de leurs pâturages pendant le temps de la sécheresse; et, quand l'herbe qui repousse a atteint la longueur du doigt, on [p. xxxiij] voit constamment plusieurs plantes fleuries parmi les feuilles naissantes des *Graminées.* Ces plantes ont toujours des tiges petites, souvent velues; des feuilles sessiles et mal développées, et d'assez grandes corolles. On pourroit croire que ce sont des espèces distinctes qui appartiennent en particulier aux *quemadas,* comme d'autres croissent exclusivement dans les forêts vierges ou sur le sommet des hautes montagnes; mais une comparaison attentive prouve que ces prétendues espèces ne sont autre chose que des individus avortés d'espèces naturellement plus grandes, et qui, abandonnées à elles-mêmes, fleurissent ordinairement dans une autre saison. A l'époque où l'on met le feu aux pâturages, la végétation de la plupart des plantes qui les composent est en quelque sorte suspendue, et elles n'ont que des tiges languissantes ou desséchées; cependant il doit arriver nécessairement, pendant cet intervalle de repos, la même chose que dans nos climats: les racines doivent se fortifier et se remplir de sucs destinés à alimenter des tiges et des pousses nouvelles, comme on en voit un exemple frappant dans le *colchique* et dans les *orchidées.* Le brûlement des tiges anciennes détermine la naissance d'autres tiges; mais, comme celles-ci paraissent avant le temps, et que les réservoirs destinés à les nourrir ne sont pas encore remplis, elles restent naines, et une floraison prématurée, amenée par le prompt épuisement des sucs, vient bientôt mettre un terme à leur existence.

Après avoir traversé plusieurs villages beaucoup plus jolis que tous ceux de l'intérieur de nos provinces, mais qui chaque jour deviennent plus déserts, j'arrivai à une forêt fort différente de celle de la côte, et qui, n'ayant que neuf lieues de longueur, porte cependant le nom de Mato-Grosso (1), parce qu'on n'en connoît pas dans le pays de plus considérable.

La seule présence de l'or a presque toujours déterminé le choix [p. xxxiv] des lieux où ont été fondées les villes de l'intérieur du Brésil, et leur situation s'est trouvée la plus désavantageuse possible sous tous les autres rapports. Villa-Rica, Villa-do-Principe, Villa-Boa, chef-lieu de la province de Goyaz, en fournissent des exemples frappans; et cependant juger toute cette dernière province par sa capitale, ce seroit encore en prendre une idée trop favorable. Lorsque l'or abondoit dans cette contrée, on établit à Villa-Boa un capitaine-général et un ouvidor; on y plaça de nombreux employés, et l'on y éleva un hôtel pour la fonte de l'or. Mais les mines se sont épuisées, ou ne pourroient plus être exploitées aujourd'hui

(1) Grand bois.

qu'avec un grand nombre de bras; et l'éloignement de la côte ne permet guère aux habitans de trouver, comme les Mineurs, une autre source de richesse dans la culture des terres. Ne pouvant payer l'impôt, ils abandonnent leurs habitations, se retirent dans les déserts, et ils y perdent jusqu'aux élémens de la civilisation; les idées religieuses, l'habitude de contracter des liens légitimes, la connoissance de la monnoie, et l'usage du sel: un pays plus grand que la France s'épuise en faveur de quelques employés indolens, et les environs même de Villa-Boa (1) n'offrent plus que des ruines sans souvenir.

En quittant cette ville j'allai faire une excursion dans la Serra-Dorada, et j'y trouvai une *Mélastomée,* qu'on appelle dans le pays *Arvore do papel,* parce que son liber se détache en feuillets minces qui ont effectivement la couleur et la consistance du papier de la Chine.

De la Serra-Dorada, je me rendis à S.-Joze, où l'un des gouverneurs de Goyaz a fondé pour les Indiens Coyapos un village magnifique, mais qui leur a été à peu près inutile, parce qu'on n'avoit pas songé à consulter auparavant leurs goûts et leurs habitudes. Les hommes qui civilisèrent les Indiens de la côte se servoient d'eux [p. xxxv] pour construire les villages que ces mêmes Indiens devoient habiter, et ils surent les rendre heureux à peu de frais. Depuis cette époque, le gouvernement portugais a dépensé pour les indigènes des sommes considérables, mais ceux qui en dirigeoient l'emploi ne prenoient aux Indiens aucun intérêt réel, et la destruction de ces infortunés fait chaque jour des progrès plus rapides (2).

Le Rio-Claro, qui fut le terme de ce voyage, me donna une idée de ce que dût être l'intérieur du Brésil lorsque l'on commença à y découvrir des mines d'or. Dans le temps de la sécheresse, des hommes de Villa-Boa, Meia-Ponte et souvent de beaucoup plus loin, viennent chercher dans le lit du Rio-Claro de l'or et des diamans; ils apportent avec eux quelques provisions indispensables; ils construisent des baraques sur les bords de la rivière, et, quand les vivres leur manquent, ils y suppléent par leur chasse.

J'avois formé le projet de me rendre par l'intérieur du Brésil au Paraguay proprement dit, et de là à Montevideo; mais le ministère portugais, envers lequel je ne saurois d'ailleurs être trop reconnoissant, ayant cru devoir interdire à tout étranger l'entrée de la province de Mato-Grosso, je fus obligé de revenir sur mes pas. Je repassai par Villa-Boa et Meia-Ponte, et pris le chemin de Saint-Paul.

Arrivé à Bom-Fim, je me détournai de ma route pour aller visiter des sources d'eaux thermales situées à vingt-deux lieues de ce village. A l'endroit où je passai le Riberaô-d'Agoaquente, ruisseau dû à quelques unes de ces sources, il a déjà trente-quatre pas de largeur avec deux palmes et demi de profondeur, et cependant ses eaux font monter à 28 degrés le thermomètre de Réaumur.

[p. xxxvj] Rentré dans la province des Mines, je passai par le Rio-das-Pedras, Estiva et Boa-Vista, trois villages habités par des Indiens dont le sang est mélangé à celui de la race africaine. Ces Indiens sont les plus

(1) On lui a donné récemment le nom de *Cidade de Goyaz;* mais l'ancien nom prévaut toujours dans le pays.

(2) Je ne saurois m'empêcher de citer deux hommes dont le zèle bienfaisant n'a point été sans utilité pour les Indiens, l'abbé Chagas, chargé de la civilisation de ceux de Garapuava, et un Français, M. le major Marlier, fondateur de Manoelburgo, où il a réuni plusieurs milliers de Puris.

heureux que j'aie vus pendant tout mon séjour en Amérique, et leur bonheur tient, il faut l'avouer, à ce qu'ils vivent isolés, oubliés pour ainsi dire, et à ce qu'aucun homme de notre race n'est venu se mêler parmi eux. Leurs terres sont excellentes, et un léger travail suffit pour assurer leur subsistance. Ils ont peu de besoins, et encore moins de tentations; ils vivent dans une paix profonde, et sont unis entre eux; ils connoissent les avantages les plus réels de la civilisation, et en ignorent les maux; ils sont étrangers au luxe, à la cupidité, à l'ambition, et à cette prévoyance qui empoisonne le présent pour un avenir incertain.

Je visitai la belle cascade d'as Fornas, et passai par le village de Santa-Anna, habité par des Indiens Chicriabas, dont la langue, si j'en juge par le peu de mots que j'ai pu recueillir, doit être éminemment systématique, puisque ceux de ces mots qui représentent des idées de même nature commencent ou finissent par une même syllabe.

Jusqu'au mois d'octobre, époque à laquelle j'entrai dans la province de Saint-Paul, la sécheresse avoit été excessive; je passai souvent des jours entiers sans apercevoir plus de deux ou trois fleurs appartenant à des espèces communes; les coléoptères avoient disparu, les oiseaux devenoient rares; j'étois dévoré par des nuées d'insectes malfaisans, forcé quelquefois de séjourner sur les bords de quelque rivière malsaine, telle que le Rio-Grande, et, à la fin d'une journée fatigante, je n'avois pas même la consolation de m'entretenir avec un hôte hospitalier; car ceux qui habitent les bords de cette route sont pour la plupart des hommes grossiers, souvent des criminels qui ont fui leur pays pour échapper à la justice, et le passage des caravanes qui se rendent chaque année de S.-Paul à Mato-Grosso les met en défiance contre les voyageurs.

[p. xxxvij] Au mois d'octobre les pluies recommencèrent à tomber, les pâturages à reverdir et à se couvrir de fleurs; mais ici la végétation n'est déjà plus aussi variée que dans la province des Mines.

Vers la ville de Mugy, le pays devient beaucoup moins désert, et aux *campos* succèdent des forêts où les terres sont extrêmement favorables à la culture de la canne à sucre.

J'arrivai enfin à Saint-Paul, cité bien connue par la beauté et les avantages de sa situation, par la douceur de son climat et la salubrité de l'air qu'on y respire.

Peut-être trouve-t-on chez les habitans de la ville de Saint-Paul plus de politesse que chez ceux de Villa-Rica; mais, si nous faisons abstraction des deux capitales, l'avantage de la comparaison sera entièrement du côté des Mineurs. Pour en développer toutes les causes, il faudroit sortir des bornes de cette introduction: je me contenterai d'en indiquer une. Si les Mineurs se sont mélangés, ce n'est guère qu'avec les hommes de la race africaine; les Paulistes au contraire se sont croisés avec les Indiens, et, sous le rapport du développement des facultés intellectuelles, ce mélange me paroît le plus défavorable à notre espèce.

Je laissai entre les mains du gouverneur de la province de Saint-Paul (1) les collections que j'avois formées depuis Rio-de-Janeiro, et je continuai mon voyage.

(1) M. Jean-Charles-Auguste d'Oyenhausten, qui m'a comblé de marques de bienveillance et d'amitié.

Sachant qu'il y a plus d'uniformité dans la végétation des côtes que dans celle de l'intérieur, je préférai me rendre à l'extrémité de la province de Saint-Paul, en passant à l'ouest de la grande cordillière parallèle à l'Océan.

Je traversai la jolie ville d'Hytu (1), et je vis dans ses environs [p. xxxviij] une très-belle cascade; je visitai Porto-Feliz, d'où partent les caravanes qui se rendent à Mato-Grosso par les rivières, et j'arrivai à la ville de Sorocaba (2), près de laquelle sont des forges qui, lorsqu'elles seront dirigées par une administration intelligente et économe, pourront rivaliser avec ce que l'Europe présente de meilleur en ce genre.

Des pluies extrêmement abondantes commencèrent à tomber lorsque j'étois à Sorocaba: elles continuèrent durant trois mois jusqu'à mon arrivée à Curitiba (3), et, pendant ce voyage, j'eus une peine extrême à conserver les objets d'histoire naturelle que je recueillois chaque jour.

De Sorocaba à la rivière du Tarerè (4), remarquable par diverses singularités, le pays est ondulé, et n'offre que des pâturages mêlés de bouquets de bois. On s'y occupe surtout de l'éducation des bestiaux; mais les principaux propriétaires habitent Saint-Paul, et la plupart de ceux qui restent dans le pays vivent dans une indigence dont j'ai eu peu d'exemples dans les autres parties du Brésil.

A un quart de lieue du Tarerè, je trouvai une rivière peu profonde (Rio-do-Funil, rivière de l'entonnoir), qui, après avoir coulé sur un lit de rochers aplatis, s'engouffre en tournoyant avec impétuosité, et disparoît entièrement. Conduit par mon guide, je descendis dans un ravin profond, et là j'arrivai à l'entrée d'une grotte fort grande et à peu près triangulaire. Au fond de cette grotte est une ouverture qui donne sur une petite salle arrondie, et du haut de cette dernière, je vis se précipiter avec rapidité une co-[p. xxxix]lonne d'eau écumeuse et blanchâtre, qui n'est autre chose que la rivière elle-même dont les eaux s'échappent dans le ravin. Une lumière affoiblie pénètre par l'entonnoir où la rivière s'engouffre, éclaire la colonne d'eau ainsi que la salle où elle tombe, et produit un effet charmant qu'il seroit impossible de rendre.

C'est de l'autre côté du Tarerè que commencent les *campos,* que l'on appelle *geraes,* à cause de leur vaste étendue. Ce pays est certainement un des plus beaux que j'eusse vus depuis que j'étois au Brésil. Il n'est pas assez plat pour avoir la monotonie de nos plaines de Beauce, mais les mouvemens de terrain n'y sont pas non plus assez sensibles pour mettre des bornes à la vue. Aussi loin qu'elle peut s'étendre, on découvre une immense étendue de pâturages; des bouquets de bois où domine l'utile et majestueux *araucaria,* sont épars çà et là dans les enfoncemens, et contrastent par leur teinte rembrunie avec le vert charmant des gazons: quelquefois des rochers à fleur de terre se montrent sur le penchant des collines, et laissent échapper des nappes d'eau qui se précipitent dans les vallées; de nombreux troupeaux de jumens et de bêtes à corne paissent dans la campagne et animent le

(1) Ce mot vient d'*itu,* qui dans la langue indienne signifie cascade.

(2) Pour *sorocda,* ind., bois brisé.

(3) C'est à tort que l'on a écrit *corritiva.* Le nom de cette ville, dû aux *araucaria* qui croissent dans son voisinage, vient des deux mots indiens *curii* et *tiba,* réunion de pins.

(4) Pour *itarere,* ind., pierre qui tourne avec vitesse.

paysage; on aperçoit peu de maisons, mais elles sont assez bien entretenues, couvertes en tuiles, et accompagnées d'un petit jardin planté d'arbres fruitiers.

Le froment se cultive avec succès dans les Campos geraes; le laitage y est aussi crêmeux que dans nos montagnes; et les coignassiers, la vigne, les pommiers, les pêchers, y donnent des fruits en abondance.

Respirant un air pur, sans cesse occupés à monter à cheval, à jeter le lacet, ou à rassembler les bestiaux, en galoppant dans les pâturages, les habitans des Campos geraes jouissent d'une santé robuste; ils ont les cheveux châtains et le teint coloré, et sont en général grands et bien faits. Je ne retrouvai pas chez eux la même intelligence que chez les Mineurs; mais ils ne sont ni moins généreux ni moins hospitaliers.

[p. xl] Les plantes des Campos geraes ont quelques rapports avec celles de la province de Rio-Grande; mais elles en conservent davantage encore avec la végétation des parties plus septentrionales du Brésil.

Entre Saint-Paul et Curitiba, je vis s'arrêter successivement la culture des diverses productions coloniales, dont les limites sont ici le résultat combiné de la nature de chaque plante, de l'élévation du sol, et de l'éloignement de l'équateur.

Sorocaba, située à dix-huit lieues de Saint-Paul, forme la ligne des cafféiers; Itapitininga (1), qu'on rencontre à douze lieues plus loin vers le sud, fait la limite de la canne à sucre; à quinze lieues de là, près d'Itapeva (2), on ne trouve plus de bananiers; enfin, quarante lieues plus loin, près de la Serra-das-Fornas, s'arrêtent les cotonniers, ainsi que les ananas.

La partie de la province de Saint-Paul que j'avois parcourue entre cette ville et Curitiba, est une langue de terre étroite, bordée vers l'ouest par des déserts qu'habitent des Indiens sauvages, et à l'est par la grande cordillière parallèle à l'Océan. Cette langue de terre, longue d'environ cent trente lieues, n'a aucune communication avec la côte, dont elle n'est cependant éloignée que de vingt lieues (3). Faute de moyens d'exportations, les habitans des Campos geraes tirent peu de parti de leurs terrains fertiles, et ils se livrent presque tous au commerce aventureux des mulets, qu'ils vont chercher, en bravant mille dangers, dans la province de Rio-Grande.

Les Curitibanois se vantent de posséder le *quina* du Pérou, et dans les cas où l'on conseille parmi nous l'usage de cette plante, [p. xlj] ils emploient effectivement avec succès une écorce remarquable par son excessive amertume. Il étoit évident qu'un véritable *Cinchona* ne pouvoit croître aussi loin des tropiques: j'examinai le *quina* de Curitiba, et le reconnus pour un *Solanum*.

Une plante non moins intéressante croît en abondance dans les bois voisins de Curitiba; c'est l'arbre connu sous le nom d'*arvore do mate* ou *da congonha*, qui fournit la fameuse *herbe du Paraguay*. Comme les circonstances politiques rendoient alors presque impossibles les communications du Paraguay proprement dit avec Buenos-Ayres et Montevideo, on venoit de ces villes chercher le *mate* à Parannagua (4), port voisin de Curitiba.

(1) Pour *itapetiny*, ind., pierre qui résonne.

(2) C'est-à-dire *chemin pierreux*.

(3) Il existe un point de communication par Apyahy; mais cette route présente trop peu de facilités pour être fréquentée.

(4) Grande étendue d'eau arrondie *ou* anse.

Les Espagnols-Américains, trouvant une grande différence entre l'herbe préparée au Paraguay et celle du Brésil, prétendoient que celle-ci étoit fournie par un autre végétal. Des échantillons que j'avois reçus du Paraguay me mirent en état de signaler aux autorités brasiliennes l'arbre de Curitiba comme parfaitement semblable à celui du Paraguay; et leur identité m'a encore été plus évidemment démontrée, lorsque j'ai vu moi-même les quinconces d'arbres de *mate* plantés par les jésuites dans leurs anciennes missions. Si donc le *mate* du Paraguay est supérieur pour la qualité à celui du Brésil, cela tient uniquement à la différence des procédés que l'on emploie dans la préparation de la plante. Jusqu'ici, les auteurs ont été peu d'accord sur le genre auquel il faut la rapporter; l'ayant trouvée avec des fruits, j'ai pu l'analyser, et dans un mémoire qui fera partie de l'ouvrage que je publie aujourd'hui, je démontrerai que cette même plante appartient au genre *Ilex* (1).

[p. xlij] Au-delà de Curitiba, le Brésil est en quelque sorte interrompu, puisque, du côté de la mer, on trouve ces montagnes presque inaccessibles appelées Serra-de-Parannagua, et que d'un autre côté on ne peut pénétrer dans la province de Rio-Grande qu'en traversant un affreux désert de plus

(1) Ilex Mate N. *glaberrima: foliis cuneato-lanceolatove-ovatis, oblongis, obtusiusculis, remote serratis; pedunculis axillaribus, multipartitis; stigmate 4-lobo; putaminibus venosis.*

Dans mon mémoire sur l'*herbe du Paraguay,* on trouvera la description et la figure d'une plante que les habitans de quelques parties du district de Minas-Novas prennent pour une espèce de *Congonha,* et qui doit trouver sa place non loin du *Sauvagesia* dans le groupe des *Frankeniées.* Cette plante appartient à un genre que je dédie à M. le duc de Luxembourg, sous les auspices duquel j'ai commencé mes voyages. Je caractérise ce genre de la manière suivante:

Luxemburgia. *Calyx inæqualis, deciduus. Petala* 5, *hypogyna, subinæqualia, decidua. Antheræ gynophoro brevissimo cum pistillo insertæ, subsessiles, definitæ sæpiùsve indefinitæ, lineares,* 4-*gonæ,* 2-*loculares, posticæ, apice poris* 2 *dehiscentes, in massulam concavam secundam adglutinatæ, deciduæ: filamentorum rudimenta persistentia. Pisillum declinatum. Stylus pyramidato-subulatus. Stigma simplex vel rariùs* 3-*partitus. Ovarium sessile vel pedicellatum, oblongum,* 3-*angulare,* 1-*loculare vel subuniloculare, polyspermum. Capsula* 1-*locularis, polysperma,* 3-*valvis; valvularum marginibus plùs minùsve introflexis, seminiferis. Semina numerosa, oblonga, membranâ cincta apice latiore. Integumentum duplex, utrumque membranaceum: umbilicus ad extremitatem seminis angustiorem. Perispermum carnosum, parcum. Embryo axilis, rectus, oblongus: radicula umbilicum ferè attingens.—Frutices elegantes, ramosi, glaberrimi. Folia alterna, dentata, mucronata, oblonga; nervis lateralibus parallelis, numerosis. Stipulæ laterales, geminæ, caducæ vel persistentes. Flores terminales pulchrè racemosi vel corymbosi, lutei: pedunculi pauld supra basin articulati, ad articulationem* 2-*bracteati. Praefloratio subquinconcialis; petalum exterius* 1, *semi-exteriora* 1-2, *dorso nudum* 1, *interiora* 1-2. — Species: 1°. Luxemburgia speciosa; *foliis subsessilibus, oblongis, obtusis, basi attenuatis; floribus racemosis, magnis; staminibus numerosis.* 2°. Luxemburgia corymbosa; *foliis breviter-petiolatis, oblongis, angustis, acutiusculis, basi attenuato-cuneatis; floribus paucis, corymbosis, magnis; staminibus numerosis.* 3°. Luxemburgia polyandra; Aug. St.-Hil. Mem. Mus. ix, p. 351. — Dec. Prod. 1, p. 350 (Vulg. Congonha do campo.) *Foliis petiolatis, oblongo-ellipticis, basi subcuneatis; floribus racemosis mediocribus; staminibus numerosis.* 4° L. octandra; Aug. de St.-Hil. l. c. — Dec. Prod. l. c. *Foliis subsessilibus, oblongo-linearibus, angustis, basi attenuato-subcuneatis; floribus racemosis, parvis; foliolis calycinis ciliatis; staminibus definitis* (7-12).

N. B. Dans quelques exemplaires des Mémoires du Muséum (vol. ix) où j'ai fait connoître le *Mate,* le nom d'*Ilex Paraguariensis* a été substitué par inadvertance à celui d'*Ilex Mate* qui doit rester à la plante.

de soixante lieues, qui sert de retraite à [p. xliij] des Indiens sauvages (1). Il entroit sans doute dans l'ancien système colonial d'isoler les provinces, afin qu'il fût plus facile de les tenir dans l'oppression.

Après avoir hésité long-temps sur le parti que je devois prendre, je me décidai à descendre la Serra-de-Parannagua, et je ne tardai pas à reconnoître que l'on ne m'en avoit point exagéré les difficultés.

J'arrivai sur le rivage, après avoir fait quelques lieues vers l'est, et j'y retrouvai des plantes que je ne rencontrois plus depuis longtemps à l'ouest de la grande cordillière: je revis des cotonniers, des bananiers, la canne à sucre, les cafféiers, les cecropia, et une foule d'espèces qui appartiennent à la Flore de Rio-de-Janeiro.

Les habitans de Parannagua achètent chèrement les avantages de posséder ces productions utiles, car leur pays, tout à la fois chaud et marécageux, est d'une extrême insalubrité. Les enfans et les gens du peuple y ont généralement le teint jaune et l'air languissant, et ceux même qui se nourrissent avec le plus de soin, sont loin d'avoir cette santé robuste dont jouissent les bons cultivateurs des Campos-Geraes.

Le petit port de Guaratuba (2), où je me rendis après avoir [p. xliv] quitté Parannagua, doit son nom à l'immense quantité d'*ibis rubra* que l'on voit dans son voisinage. Depuis Santos, ce bel oiseau se trouve sur quelques points de la côte; mais on s'accorde à dire qu'il ne fait son nid que dans l'île des Guaras, située dans la baie de Guaratuba.

A Parannagua, Guaratuba, et plus au midi dans la province de Sainte-Catherine, on trouve une foule d'hommes et de femmes qui ont le goût bizarre de manger de la terre. Ils donnent la préférence à celle qui est tirée des habitations de thermès, et font aussi un très-grand cas des morceaux de pots cassés; les jeunes personnes surtout sont friandes de certains vases légèrement parfumés, qui viennent de Bahia, et elles les brisent pour s'en régaler ensuite. Ce goût devient une telle passion, qu'on a vu des esclaves, que l'on avoit muselés, se traîner dans la poussière pour pouvoir en aspirer quelques particules. Cependant les infortunés qui sont attaqués de cette maladie singulière maigrissent peu à peu, languissent, se dessèchent, et finissent par mourir.

A peu de distance de Guaratuba, je passai la petite rivière appelée Sahy-Mirim (3), et j'entrai dans la province de Sainte-Catherine. Suivant toujours le rivage, j'arrivai à la hauteur de l'île de Saint-François (4), et je m'y arrêtai pendant une dixaine de jours. Les habitans de cette île vivent généralement dans une extrême indigence; accoutumés à se nourrir de farine de manhioc et de poisson cuits dans de l'eau, ils ne cherchent point à se procurer, par le travail, des alimens plus substantiels, et la débilité de leur complexion augmente encore leur indolence. De quelque [p. xlv] état que

(1) C'est à tort qu'on a prétendu que ces Indiens étoient anthropophages: les Portugais eux-mêmes ne les ont jamais accusés de l'être. On ne peut en général s'empêcher de voir avec peine que des écrivains estimables appliquent encore aux Indiens d'aujourd'hui ces traits de barbarie, probablement fort exagérés, qui se trouvent dans les premiers historiens du Brésil.

(2) Des mots indiens *tuba*, réunion, et *guara*, oiseau de mer.

(3) Pour *sai miri*, ind., petits yeux.

(4) Il est inutile, je crois, de relever l'inadvertance d'un moderne qui dit avoir été à Saint François, et qui prétend que ce n'est point une île. Sa description me fait soupçonner au reste qu'il applique le nom de Saint-François au port de Parannagua.

soit un homme, il est en même temps pêcheur; il n'est personne qui ne possède une pirogue, et personne qui ne sache la diriger avec adresse. On voit les femmes s'embarquer sur une mer houleuse dans ces frêles nacelles, et elles ne montrent pas la plus légère frayeur. La mer est l'élément des habitans de Saint-François; à peine l'enfant commence-t-il à parler, qu'il sait déjà de quel côté vient le vent, et quelles sont les heures de la marée; et de même qu'on dit, dans les *Campos-Geraes,* pour exprimer l'abondance d'une chose quelconque, qu'on en chargeroit un mulet, on dit, à Saint-François, qu'on en rempliroit une pirogue.

Lorsque j'étois parmi les Malalis, dans la province des Mines, ils m'avoient beaucoup parlé d'un ver qu'ils regardent comme un manger délicieux, et qu'on appelle *bicho de tacuara* (1), parce qu'il se trouve dans les tiges des bambous, mais seulement lorsqu'elles sont chargées de fleurs. Quelques Portugais, qui ont vécu parmi les Indiens, ne font pas moins de cas de ces vers que les indigènes eux-mêmes; ils les fondent sur le feu, en forment une masse graisseuse, et les conservent ainsi pour s'en servir dans la préparation des alimens. Les Malalis considèrent la tête du *bicho de tacuara* comme un poison dangereux; mais tous s'accordent à dire que cet animal, desséché et réduit en poudre, forme un puissant vulnéraire. S'il faut croire ces Indiens et les Portugais eux-mêmes, ce n'est pas seulement pour cet usage que les premiers conservent le *bicho de tacuara.* Lorsqu'une passion violente leur cause des insomnies, ils avalent, disent-ils, un de ces vers desséché et séparé de sa tête, mais non du tube intestinal; et alors ils tombent dans une espèce de sommeil extatique, qui souvent dure plus d'un jour, et ressemble à celui qu'éprouvent les Orientaux quand ils prennent de l'opium avec excès. Ils racontent, en se réveillant, des songes merveilleux: ils ont vu des forêts brillantes, ils ont mangé des fruits dé-[p. xlvj]licieux, ils ont tué sans peine le gibier le plus exquis; mais les Malalis ajoutent qu'ils ont soin de ne se livrer que rarement à ce genre de jouissance énervante. Je n'avois vu chez eux que des *bichos de tacuara* desséchés et séparés de leur tête; mais, dans une herborisation que je fis à Saint-François avec mon Botocudo, ce jeune homme trouva un grand nombre de ces vers dans des bambous fleuris, et se mit à les manger en ma présence. Il brisoit l'animal, en ôtoit avec soin la tête et le tube intestinal, et suçoit la substance molle et blanchâtre qui restoit sous la peau. Malgré ma répugnance, je suivis l'exemple du jeune sauvage, et trouvai, à ce mets singulier, une saveur extrêmement agréable qui rappeloit celle de la crême la plus délicate.

Si donc, comme je ne puis guère en douter, le récit des Malalis est fidèle, la propriété narcotique du *bicho de tacuara* résideroit uniquement dans le tube intestinal, puisque la graisse environnante ne produit aucun accident. Quoi qu'il en soit, j'ai soumis à M. Latreille la description que j'ai faite de l'animal dont il s'agit, et ce profond entomologiste l'a reconnu pour une chenille qui probablement appartient au genre *cossus* ou au genre *hépiale.*

De l'île Saint-François je me rendis, en suivant toujours le rivage, jusqu'à l'*armaçaô* d'Itapocoroïa (2), l'un des établissemens de la pêche de la

(1) *Ver du bambou.*
(2) Pour *itapacora,* ind., qui a la forme d'un mur de pierres.

baleine. Il y a déjà un grand nombre d'années que le gouvernement portugais profite de cette pêche et la met en ferme. Toute la pêcherie se compose actuellement de huit établissemens (armacoês) (1), dont deux dans la province de Saint-Paul, et les six autres dans celle de Sainte-Catherine; mais, comme l'a observé un illustre zoologiste, les grands cétacés deviennent de plus en plus rares. Depuis 1777, époque où a été construit l'établissement d'Itapocoroïa, on a [p. xlvij] encore pris dans son voisinage jusqu'à trois cents baleines en une seule année, et, en 1819, il n'en a été pêché que cinquante-neuf dans tous les établissemens réunis.

Je m'embarquai à Itapocoroïa, pour me rendre à l'île de Sainte-Catherine. Depuis que j'étois au Brésil, je n'avois pas encore vu un pays aussi riant que la ville Sainte-Catherine et ses environs. En face de cette ville, la canal, qui sépare l'île de la terre ferme, semble former une baie à peu près circulaire. De tous côtés, il est bordé de collines et de petites montagnes très-variées pour la forme, et qui, disposées sur différens plans, offrent un mélange charmant de teintes brillantes et vaporeuses. L'azur du ciel n'est plus aussi foncé ni aussi éclatant qu'à Rio-de-Janeiro, mais il est aussi pur, et se nuance dans le lointain avec la couleur grisâtre des mornes qui bornent l'horison. Les montagnes n'ont pas assez d'élévation, ni le canal assez d'étendue pour donner au paysage un air de majesté; la nature n'étale point cette pompe qu'elle offre quelquefois sous les tropiques, elle est belle et riante comme dans le midi de l'Europe, comme à Lisbonne ou à Madère.

Comme la même température se prolonge sous le même méridien dans une étendue beaucoup plus considérable sur le bord de la mer que loin de ses rivages, la végétation a généralement aussi beaucoup plus d'uniformité sur le littoral que dans l'intérieur des terres: ce qu'on observe à Sainte-Catherine confirme cette vérité. Lorsque j'arrivai à Curitiba, il y avoit déjà extrêmement long-temps que je ne voyois plus les plantes de Rio-de-Janeiro; et les deux tiers des végétaux que je trouvai en fleur dans l'île Sainte-Catherine appartenoient à la Flore de la capitale du Brésil. Une foule d'insectes sont communs aux deux pays, et beaucoup d'oiseaux, surtout les petites espèces, se retrouvent également à Sainte-Catherine et à Rio-de-Janeiro.

Je m'embarquai pour me rendre à Garupava, l'un des établissemens de la pêche de la baleine, situé à treize lieues sud de la ville de Sainte-Catherine. Ce fut le premier point de la côte où je com-[p. xlviij]mençai à observer des changemens notables dans la végétation; mais, sous cette latitude, la différence de l'été et de l'hiver est déjà très-sensible: on étoit au mois de mai, et je ne trouvois presque plus de plantes en fleur.

A Laguna, ville bâtie sur la côte, à environ onze lieues sud de Garupava, j'observai une foule d'oiseaux que je n'avois pas encore vus au Brésil, et que je continuai à trouver pour la plupart, en m'avançant toujours vers le midi.

Dans les provinces de Rio-de-Janeiro, Minas-Geraes, Saint-Paul, Goyaz, le pays est trop montueux pour qu'on puisse voyager autrement qu'avec des mulets. Depuis Parannagua jusqu'à Laguna, j'éprouvai des difficultés

(1) *Armasaô* est un mot portugais générique; il n'auroit donc point fallu en faire le nom particulier d'un village, ou le changer en *armasas*.

inconcevables pour le transport de mes collections; mais, au-delà de cette ville, le sol devient tellement égal que l'on peut commencer à se servir de ces immenses charrettes décrites par Azzara.

Pour arriver jusqu'à Torres, un peu plus loin que la rivière d'Ararangua, limite de la province de Sainte-Catherine, on suit une plage déserte et monotone qui n'offre que des sables blanchâtres et arides. Une *Amaranthacée,* un *Sénéçon* à tiges longues et rampantes, et quelques touffes de *Cypéracés* sont les végétaux qui croissent sur ces tristes rivages, où sept à huit espèces d'oiseaux aquatiques jettent seuls un peu de mouvement et de variété. D'innombrables *mouettes à tête cendrée* (1), rangées sur le sable, presque immobiles, la tête tournée vers la mer, attendent l'instant où le flot, baignant leurs pieds, va leur apporter leur nourriture. Les *grandes mouettes,* Azz. (2), mêlées parmi elles, mais beaucoup moins nombreuses, guettent de petits poissons. Le cou tendu et la tête placée sur la même ligne que le dos, les *manoelsinhos* ou *massaricos* (3) courent sur la plage avec [p. xlix] une extrême vitesse, et ressemblent de loin à de petits quadrupèdes. Plusieurs espèces d'hirondelles de mer (4) viennent se reposer au milieu des mouettes; mais bientôt elles reprennent leur vol. Enfin le *baïacu* (5), qui va ordinairement par paire, se tient à quelques centaines de pas du rivage.

Les coquilles ne sont pas abondantes au Brésil, et je n'ai trouvé de *fucus* que sur un très-petit nombre de points entre Rio-de-Janeiro et Villa-da-Victoria.

Au-delà de Torres et de la rivière d'Ararangua (6), je m'éloignai peu à peu du rivage pour me rendre à Porto-Allegre, capitale de la province de Rio-Grande du sud.

Cette province, qui s'étend depuis le 27° 51′ S. jusqu'au 33°, est une de celles que la nature a favorisées le plus. Son territoire fertile produit, dans la partie septentrionale, du sucre, du coton, du manhioc; et vers le midi, du froment et tous les fruits de l'Europe (7); l'air le plus pur fait jouir les habitans de ce pays d'une santé robuste; d'excellens pâturages y nourrissent d'innombrables troupeaux; un lac de soixante-quinze lieues et de nombreuses rivières facilitent les communications et fournissent des moyens de transport.

Lorsque le voyageur entre dans la province de Rio-Grande, il est d'abord frappé de la beauté de ses habitans, de la fraîcheur de leur teint, des couleurs dont il est animé, de la vivacité de leurs mouvemens, de cet air d'aisance et de liberté qu'ils montrent dans leurs manières. Le systême colonial, tendant à isoler les provinces, a mis des différences beaucoup plus sensibles entre leurs habitans qu'il n'en [p. l] existe en Europe parmi ceux de la plupart des états limitrophes. Ces différences sont bien plus frappantes encore chez le peuple de Rio-Grande, parce qu'il vit sous un autre climat, qu'une

(1) *Larus poliocephalus,* vulg. *Gaïvota.*

(2) *Larus vetula* Mus. Par. sp. n., vulg. *Maria velha* ou *Gaïvota grande.*

(3) *Charadrius larvatus.*

(4) Les *sterna speculifera* Mus. Par. sp. n., *Cayana* Lath., *hirundinacea* Mus. Par. sp. n. Vulg. *trinta reis.*

(5) *Hæmatopus palliatus* Mus. Par. sp. n.

(6) Pour *ararerunguay,* ind., rivière de sable noir.

(7) Je ne veux pas dire que le froment ne croisse point aussi dans les parties septentrionales de la province de Rio-Grande.

autre nourriture, un régime différent, d'autres localités ont fait naître chez lui d'autres mœurs et d'autres habitudes. Ainsi, par exemple, les Mineurs sont portés aux idées contemplatives par leur tempérament un peu hypocondriaque et leur vie inactive: les hommes de la province de Rio-Grande, qui mènent une vie extérieure et presque animale, sont à peu près étrangers aux sentimens religieux. Dans la province des Mines, les mariages sont rares, et les femmes, enfermées dans l'intérieur de leur maison, ne sont que les premières esclaves de leurs maris: dans celle de Rio-Grande, les femmes ne se cachent point, les unions légitimes sont plus communes, et les mœurs sont plus pures. Les Mineurs commettent quelquefois des crimes par trahison: les autres en commettent avec audace. Les premiers sont doux, polis, affectueux, communicatifs: les derniers ont des formes brusques et grossières. La rare intelligence des Mineurs, leur facilité pour apprendre, l'envie qu'ils ont de s'instruire sont généralement connus; quand je voyageois dans leur pays, j'étois sans cesse assailli de questions; chacun vouloit savoir quel étoit le but de mes travaux; on me demandoit tour à tour des détails sur nos arts, nos lois et notre histoire: dans la province de Rio-Grande, lorsqu'on sait galoper sur un cheval indompté, jeter le lacet, lancer les boules, châtrer un taureau, égorger un bœuf et le dépecer, on ne veut rien savoir de plus. Les Mineurs imaginent peu, mais ils imitent facilement, et ont une grande aptitude pour tous les arts et pour tous les métiers: dans la province de Rio-Grande, au contraire, les arts sont dédaignés, et la plupart des ouvriers sont des étrangers. Quoique fiers de leur patrie, les Mineurs la quittent sans peine: les habitans de Rio-Grande ne sortent point de leur pays, parce qu'ils savent qu'ailleurs il faudroit quelquefois qu'ils allassent à pied, et que nulle part ils ne trouveroient avec autant d'abondance la viande qui fait [p. lj] presque leur unique nourriture. Les Mineurs dépensent leur argent avec ostentation: les hommes de Rio-Grande ont souvent une fortune considérable, mais, à voir leurs habitations et la manière dont ils vivent, on les croiroit dans l'indigence. La province des Mines s'épuise: celle de Rio-Grande s'enrichit. Les Mineurs ont un courage ordinaire: les hommes de Rio-Grande se distinguent par une valeur brillante, et, sous un chef entreprenant, ils feroient des conquêtes faciles, partout où ils ne seroient point contrariés dans leurs goûts et dans leurs habitudes. Ces peuples cependant ont un trait frappant de ressemblance; ils sont également hospitaliers, et je dois leur vouer une égale reconnoissance.

Porto-Allegre, capitale de la province de Rio-Grande, est bâti sur une presqu'île formée par une colline qui s'avance du nord-est au sud-ouest dans le lac *dos Pathos* (1). Celui-ci doit son origine à quatre rivières navigables qui réunissent leurs eaux en face de la ville, et qui, divisées à leur embouchure en un grand nombre de branches, forment un labyrinthe d'îles (2). Il seroit difficile de peindre [p. lij] la beauté d'une telle position; ce

(1) Le nom de ce lac est celui d'une peuplade indienne qui n'existe plus aujourd'hui.

(2) Ces quatre rivières sont le Guahiba, qui plus haut porte le nom de Jacuy, le Cahy, le Rio-dos-Sinos et le Gravatahy. L'abbé Casal et d'autres ne font commencer le lac qu'au-dessous d'Itapuan, et considèrent les eaux, qui s'étendent entre ce lieu et Porto-Allegre, comme une continuation du Guahiba. Il est bien vrai qu'au-delà d'Itapuan, le lac devient beaucoup plus large; cependant lorsqu'on monte sur

n'est plus la zône torride, ses sites majestueux, et encore moins la monotonie de ses déserts; c'est le midi de l'Europe et tout ce qu'il a de plus enchanteur.

Lorsque j'entrai dans la province de Rio-Grande, on étoit au mois de juin; le froid se faisoit sentir; je ne trouvois plus de fleurs, les insectes avoient disparu, et je n'étois dédommagé que par le grand nombre d'oiseaux qui vivent sur le bord des lacs, des marais et des rivières. L'eau gela souvent pendant mon séjour à Porto-Allegre, et, quand il faisoit moins froid, il tomboit des pluies abondantes. Dans les provinces de Goyaz et des Mines, une sécheresse opiniâtre caractérise l'hiver; ici au contraire, cette saison est accompagnée de pluies presque continuelles. A cette époque, le vent du sud-ouest, appelé *minuano* (1), après avoir passé sur la grande cordillière du Chili et traversé les pampas, vient refroidir l'atmosphère. C'est à lui, s'il faut en croire les habitans du pays, qu'on doit attribuer les tétanos si fréquens à la suite de la plus légère blessure, et dans lesquels on a souvent employé avec succès, à Rio-Grande et Porto-Allegre, l'opium à grande dose, et surtout des frictions faites avec des brosses rudes.

J'ai indiqué la limite des divers produits coloniaux dans cette partie de la province de Saint-Paul, située à l'ouest de la grande cordillière brasilienne; mais j'ai dit en même temps que, sur le littoral, leur culture s'étendoit bien davantage vers le midi. On retrouve des plantations de manhioc et de sucre jusque dans le voisinage de Porto-Allegre; mais cette ville, située par le 30° 2', doit être considérée comme la véritable limite de ces plantes dans la partie orientale de l'Amérique méridionale. Quant aux cotonniers, ils s'étendent à environ un degré et demi de plus vers le sud.

Pour me rendre de Porto-Allegre à la ville de Rio-Grande-de-S.-Pedro-do-Sul, je suivis cette langue de terre étroite qui sépare le lac [p. liij] dos Pathos de l'Océan, et qui n'offre guère que des pâturages sabloneux, parsemés de bouquets de bois, et entrecoupés de lacs.

Rio-Grande-de-S.-Pedro est bâti à environ trois quarts de lieue de la mer sur le bord du canal qui établit une communication entre elle et le lac dos Pathos. Rien n'est plus triste que la situation de cette ville, puisque, de tous côtés, on ne découvre autour d'elle que des eaux, des marais et des sablès. Ceux-ci poussés, dans le temps des froids, par les vents furieux de l'ouest et du sud-ouest, volent en tourbillons, forment des monticules, pénètrent souvent dans les maisons les mieux fermées, et finissent par les engloutir. Rio-Grande s'étendoit autrefois bien davantage du côté de l'ouest; les sables ont enseveli des rues entières; mais, en revanche, la population s'est avancée peu à peu vers l'est, en formant des atterrissemens

les hauteurs voisines de Porto-Allegre, il est facile de se convaincre que le Cahy, le Rio-dos-Sinos et le Gravatahy ne se jettent point, comme le dit Casal, dans le Guahiba, mais qu'ils se réunissent avec lui dans un réservoir commun, qui, infiniment plus large que le Guahiba, n'en est pas plus la continuation que celle des trois autres rivières; et il semble même prolonger celles-ci bien plus que le Guahiba, puisqu'il s'étend dans la même direction, tandis que le Guahiba n'arrive que latéralement. C'est aussi à Porto-Allegre que l'historien de Rio-Grande, mon respectable ami M. Joze Feliciano Fernandez Pinheiro, fait commencer le lac auquel on donne à son origine le nom de lac de Viamaô ou lac de Porto-Allegre, et à son extrémité méridionale celui de lac Merim.

(1) Ce nom est celui d'une peuplade indienne.

aux dépens du lac; et des maisons qui se trouvoient, il y a trente ans, au milieu de la ville, sont aujourd'hui à son extrémité occidentale.

Je profitai de mon séjour à S.-Pedro pour aller voir, au charmant village de S.-Francisco-de-Paula, ces grandes fabriques de viande sèche (charqueadas), qui font entrer annuellement des capitaux si considérables dans la province de Rio-Grande, depuis surtout que les bestiaux ont été presque anéantis sur les bords du Rio-de-la-Plata.

Vers la fin d'août, le froid ne se faisoit plus sentir; les pêchers étoient couverts de fleurs, les gazons commençoient à verdir, et déjà je trouvois sur les pelouses quelques plantes fleuries. La plupart appartenoient à des genres européens, et ce qu'il y a de remarquable, c'est que plusieurs de ceux qui fournissent chez nous des espèces printanières sont les mêmes auxquels se rapportent les plantes qui fleurissent les premières dans la contrée que j'habitois alors. Ainsi je récoltois des *Carex,* un *Anemone,* un *Ranunculus,* ou du moins une espèce voisine de ce genre, un *Cerastium,* des *Arenaria,* un *Centunculus* (1), un *Linaria,* etc.

[p. liv] J'observai dans les environs de Rio-Grande ces chiens singuliers qu'on nomme *ovelheros* (2). Là, comme dans tout le reste du Brésil, les troupeaux n'ont point de pasteurs, et l'on n'est pas non plus dans l'usage de les enfermer dans des bergeries; mais, dans la province de Rio-Grande, ils sont exposés à des ennemis plus nombreux peut-être que partout ailleurs, entre autres, les chiens sauvages qui dévorent les brebis, et les caracaras qui arrachent les yeux des agneaux. Pour donner un défenseur au troupeau, on prend un jeune chien d'une espèce vigoureuse; on le sépare de sa mère avant qu'il ait ouvert les yeux; on force une brebis à le nourrir de son lait; on le châtre, et on lui fait une petite hutte que l'on place au milieu du troupeau. Les premiers êtres vivans qui s'offrent à sa vue sont des moutons; il s'accoutume à eux, il prend pour eux une tendre affection, devient leur protecteur, et repousse avec courage les animaux qui viennent les attaquer. Il s'habitue à aller manger matin et soir à l'habitation; d'ailleurs il ne quitte plus le troupeau; et si quelquefois les brebis s'éloignent de la maison du maître, il se prive de nourriture plutôt que de les abandonner.

[p. lv] Je quittai Rio-Grande le 19 septembre, et pour me rendre à la frontière des possessions espagnoles, je suivis cette langue de terre qui sépare de l'Océan le lac *Merim,* continuation du lac *dos Pathos.* Ce pays

(1) Les *Primulacées* sont chez nous des plantes printanières. C'est aussi au commencement du printemps que je trouvai en abondance, depuis Rio-Grande jusqu'à Maldonado, une *Primulacée* anomale qui sera l'objet d'un troisième mémoire sur le *Placenta central,* et que je caractérise de la manière suivante: Pelletiera. *Calix 5-partitus. Petala 3, hypogyna, ovata, unguiculata, distantia, calice multotiès minora. Stam. 3, basi petalorum inserta, iisdemque opposita. Stylus* 1. *Stigma capitatum. Ovarium globosum, 1-loc., 2-spermum. Ovula placentæ centrali semi-immersa orbiculari, desinente in filum cum interiore styli substanciâ continuum, mox evanidum. Capsula 3-valvis, 2-sperma. Embryo rectus, in perispermo axilis, umbilico parallelus.*—Pelletiera verna. *Herbula glaberrima, facie centunculorum. Caulis basi ascendente ramosus. Rami quadrangulares, erecti. Folia opposita, sessilia, elliptico-lanceolata, integerrima. Flores axillares, pedunculati; pedunculis folio brevioribus. Calycis divisuræ lineari-subulatæ acutissimæ. Petala alba.—In honorem dixi amicissimi D. M. Pelletier Aurelianensis, botanices peritissimi qui de gemmis arborum egregiè dissertavit.*

(2) Du mot portugais *ovelha,* brebis.

n'offre que des pâturages très-ras, parsemés de quelques bouquets d'arbres qui deviennent d'autant plus rares qu'on s'avance davantage vers le sud.

A mesure que je m'eloignois de Rio-Grande, la végétation paroissoit moins avancée, et l'influence du climat sur les plantes devenoit plus sensible. Ainsi à un degré N. de Porto-Allegre, les arbres, dans la saison la plus froide, étoient presque tous encore chargés de feuilles: à S.-Francisco-de-Paula, près Rio-Grande, à peu près le tiers des végétaux ligneux avoit perdu les siennes; et enfin, à près de deux degrés plus au sud, vers Jerebatuba (1) et Chuy (2), un dixième des arbres seulement conservoit son feuillage, et ce n'étoient guère que les espèces les moins élevées, telles que des *Myrtées,* des *Myrsinées,* une *Onagraire,* et une *Nyctaginée,* qui fleurit au cœur de l'hiver, comme chez nous l'*Helleborus hyemalis.*

Vers la hauteur de Chuy, ancienne limite méridionale des campagnes neutres (*campos neutraes*), s'arrête le lac Merim. Là, je m'écartai de ma route pour aller herboriser dans le Cerro-de-S.-Miguel, petite chaîne de collines qu'on ne peut s'empêcher de remarquer dans un pays aussi plat que celui que je parcourois. Quoique les arbres ne fussent pas encore revêtus de feuilles, je trouvai à S.-Miguel plus de plantes en fleurs que je n'aurois espéré, et je fus frappé de leurs rapports avec la Flore européenne. Je recueillis, entre autres, plusieurs *Vicia,* plusieurs *Lathyrus,* des *Asphodelées,* famille dont je n'avois trouvé aucune espèce sous les tropiques; un *Helianthemum,* un *Carex,* un *Berberis,* un *Plantain,* plusieurs *Paronichyées,* plusieurs *Caryophyllées,* un *Poa,* un *Euphorbe,* etc.

[p. lvj] Les *palmiers* paroissent s'arrêter dans cette partie de l'Amérique entre les 34 et 35° de latitude sud, ce qui correspond à peu près à la limite qu'on leur a trouvée à la Nouvelle-Hollande.

J'entrai bientôt dans les possessions espagnoles, et commençai à parcourir ces magnifiques campagnes qui furent, avant la guerre, si riches et si florissantes, et qu'on avoit appelées le paradis de la côte orientale de l'Amérique. Nulle part peut-être il n'existe de meilleurs pâturages; la terre est partout d'une grande fécondité, et les bestiaux sont beaucoup plus beaux que dans les possessions portugaises.

Je visitai les villes de Rocha, Saint-Carlos et Maldonado; j'allai herboriser dans les petites montagnes appelées Cerro-Aspro, Paô-de-Assucar, Cerro-de-las-Animas, et j'arrivai à Monte-Video.

L'occupation de cette ville et des pays circonvoisins par les troupes du Portugal avoit rendu la paix à la rive droite du Rio-de-la-Plata. L'administration portugaise et son respectable chef (3) avoient su triompher d'une haine nationale invétérée, honneur réservé à la prudence et à la modération.

La riante contrée qui s'étend depuis Monte-Video jusqu'à l'embouchure du Rio-Negro présente une immense plaine légèrement ondulée, où, quelque loin que la vue puisse s'étendre, on ne découvre presque jamais que des pâturages. L'herbe y atteint la même hauteur que dans les prés secs du milieu de la France; mais elle est plus fine que celle de nos prairies; elle se compose plus exclusivement de *Graminées,* parmi lesquelles dominent les *Stipas;* et elle n'est point, comme dans l'intérieur du Brésil, entremêlée

(1) Des mots indiens *jyriba* et *tiba,* assemblage de palmiers.

(2) Pour *juyy,* la rivière des grenouilles.

(3) Le général Lecor, baron da Laguna.

d'arbustes et de sous-arbrisseaux. Dans ces campagnes on ne voit aucun bois; mais les plus grands ruisseaux coulent entre deux [p. lvij] lisières d'arbres qui n'appartiennent qu'à un petit nombre d'espèces, et du milieu desquels s'élève un *saule* aussi élégant que pittoresque. Ces arbres n'offrent point les teintes sombres des forêts de la zône Torride; le vert de leur feuillage est plus tendre peut-être et plus agréable à la vue que celui de nos bosquets printaniers; une herbe molle croît sous leur ombrage, et le paisible *capivara* (1) vient se jouer presque aux pieds du voyageur, tandis que le *cardinal* (2) fait entendre ses chants en voltigeant sur les branchages.

Dans les environs de Rio-de-Janeiro et tant d'autres parties du Brésil, on voit des fleurs pendant toute l'année, mais on n'en trouve jamais un très-grand nombre à la fois. Au contraire, à Monte-Video, sur les bords du Rio-de-la-Plata et de l'Uruguay, les fleurs paroissent, comme chez nous, dans un espace de temps fort court, et sont alors très-abondantes. Les mois d'octobre et de novembre sont la saison où l'on en trouve le plus; en hiver la végétation est suspendue, et, pendant l'été, les campagnes sont desséchées par l'ardeur du soleil. A la fin de novembre, les plantes, autour de Monte-Video, n'offroient déjà plus la même fraîcheur; huit à dix jours plus tard, les pâturages avoient cette couleur jaunâtre que présentent nos prairies, au moment où l'on va les faucher; enfin au 25 décembre, quand j'arrivai au Rio-Negro, l'herbe des champs étoit entièrement desséchée, et si j'apercevois quelques plantes en fleur, ce n'étoit plus que sur le bord des ruisseaux.

Depuis le fort de Sainte-Thérèse, situé par le 34° de latitude sud, jusqu'à Monte-Video, et de cette ville jusqu'à l'embouchure du Rio-Negro, par le 33° quelques minutes, je recueillis environ [p. lviij] cinq cents espèces de plantes, suivant d'abord la côte et ensuite le Rio-de-la-Plata, puis l'Uruguay; et, sur ce nombre de végétaux, il est à remarquer qu'il y en a quinze seulement qui ne se rapportent à aucune des familles dont se compose la Flore de la France. Ce sont deux *Loasa,* trois *Turnera,* deux *Calycérées,* un *Sesuvium,* deux *Bignonées,* une *Commélinée,* une *Malpighiée,* une *Passiflore,* et une *Gesneriée.*

Quelques plantes européennes, telles qu'un de nos *Anagallis,* le *Leonurus cardiaca,* un de nos *Chenopodium,* se sont presque naturalisées dans les environs de Rio-de-Janeiro. La quantité d'espèces venant d'Europe est déjà plus considérable autour des villes situées dans les parties élevées de la province des Mines; ainsi, par exemple, on retrouve à Villa-Rica notre *Verveine,* une de nos *Menthes,* le *Poa annua,* etc.; et l'on voit à Tejuco le *Verbascum blattaria,* l'*Urtica dioïca,* un de nos *Xanthium,* etc. Le nombre des plantes d'Europe augmente encore dans les alentours de Saint-Paul; le *Marrubium commune* et le *Conium maculatum* croissent jusque dans les rues de cette ville; le *Polycarpon* végète sur les murs des jardins qui l'entourent, etc. Plus reculé vers le midi, Porto-Allegre a reçu beaucoup de nos espèces; ainsi l'on voit communément dans quelques-unes de ses rues les moins fréquentées l'*Alsine media,* le *Rumex pulcher,* le *Geranium robertianum,* le *Conium maculatum,* l'*Urtica dioïca,* etc. Mais nulle part les plantes d'Europe ne se sont multipliées avec autant d'abondance que dans

(1) On prononce ce mot comme je l'écris ici; cependant plusieurs auteurs ont écrit *capibara.* L'orthographe de Marcgraff se rapproche le plus des étymologies.

(2) *Loxia cuculata* Lin. Avec cette espèce on en trouve une autre à laquelle on donne aussi le nom de *cardinal,* l'*emberriza gubernatrix* Tem.

les campagnes qui s'étendent entre Sainte-Thérèse et Monte-Video, et de cette ville jusqu'au Rio-Negro. Déjà la *Violette,* la *Bourrache,* quelques *Geranium,* l'*Anethum fœniculum,* etc., se sont naturalisés autour de Sainte-Thérèse. Des plantes qui, dans leur pays natal, ne se trouvent qu'isolées, vivent en société dans les environs de Monte-Video; elles s'attachent, pour ainsi dire, aux pas de l'homme, entourent ses habitations et s'emparent des pâturages qu'il parcourt le plus. Les chemins sont bordés de deux larges bandes de fleurs [lix] d'un bleu pourpre, celle de l'*Echium maritimum* (1); l'*Avena sativa* est aussi commun dans quelques pâturages que si on l'avoit semé; on retrouve partout nos *Mauves,* nos *Anthemis,* un de nos *Erisymum,* notre *Marrube commun,* etc. Un de nos *Myagrum,* dont le premier pied parut il y a dix ans sous les murs de Monte-Video, couvre aujourd'hui presque à lui seul tout l'espace qui s'étend entre cette ville et son faubourg. J'espérois trouver beaucoup de plantes sur le Cerro-de-Monte-Video, la seule montagne qui avoisine cette ville; mais on a bâti un fort sur son sommet; des soldats la parcourent sans cesse, et sa végétation, actuellement presque artificielle, appartient en très-grande partie à la Flore de l'Europe. Cependant aucune espèce ne s'est répandue dans les campagnes du Rio-de-la-Plata et de l'Uruguay, bien au-delà du Rio-Negro, autant que le Chardon-marie (*Carduus marianus*), et surtout notre Cardon (*Cynara Cardonculus*). Comme ces campagnes étoient, avant la guerre, couvertes d'innombrables bestiaux, et que ceux-ci sont très-friands des jeunes pousses du Cardon, cette plante fleurissoit moins souvent et se multiplioit avec plus de lenteur; mais depuis que les troupeaux ont été exterminés, elle s'est étendue avec une rapidité effrayante; elle couvre aujourd'hui des terrains immenses; elle les rend inutiles pour le bétail et pour les chevaux arrêtés par ses feuilles épineuses, et elle sera un monument indestructible des discordes civiles qui ont agité cette belle contrée.

Au-delà du Rio-Negro, le pays est beaucoup moins peuplé qu'entre cette rivière et Monte-Video; il devient plus difficile à parcourir, et je me plais à reconnoître que, sans les nombreux services qui me furent rendus par MM. les officiers des troupes portugaises [p. lx] et brasiliennes cantonnées sur les bords de l'Uruguay (2), il m'eût été impossible de continuer mon voyage.

Si j'en excepte les petits jardins plantés par les soldats portugais, je ne vis, dans un espace de plus de cinquante lieues, qu'un seul quartier de terre en culture. Livrés à une insouciance dont l'Européen chercheroit vainement à se faire une idée, les habitans de ces contrées, bien peints par Azzara, n'ont d'autre occupation que de monter à cheval et de galopper sur les traces des bestiaux; comme ils ne connoissent d'autre jouissance que celle d'aspirer avec un chalumeau des infusions de maté, et de se repaître, souvent sans sel et sans pain, de viandes à demi-crues. Le peuple de Monte-Video est peut-être supérieur à celui de Rio-Grande et de Porto-Allegre; mais les campagnards de cette partie de l'Amérique espagnole que j'ai parcourue, sont

(1) C'est à tort que l'on a imprimé *Echium vulgare* dans les Mémoires du Muséum (vol. IX). Les étamines de l'*E. maritimum* sont sur le même pied, tantôt sortantes et tantôt incluses.

(2) Je dois nommer entre autres M. le général Joaô-Carlos Saldanha Oleveira e Daun et M. Galvaô, colonel de la légion de Saint-Paul. Je ne puis m'empêcher de citer également ici mon ami M. le major Joaô Pedro da Silva Ferreira.

certainement au-dessous de ceux de la province de Rio-Grande, quoique les mœurs des uns et des autres aient beaucoup de rapports. La différence tient, je crois, à ce que dans la province de Rio-Grande les habitans de la campagne, fils ou petit-fils de cultivateurs des îles Açores, sont des blancs de race pure, tandis que les campagnards espagnols sont en grande partie des métis d'Européens et d'indigènes; et ceux dont le sang n'est point mélangé ont adopté, par imitation, les mœurs du plus grand nombre.

Je visitai les catadupes de l'Uruguay, appelées Salto-Grande et Salto-Chico, et j'arrivai à Belem.

Entre ce lieu et les Missions, mon voyage devint plus pénible qu'il n'avoit jamais été; je passai treize jours dans un désert où je ne découvrois aucune habitation ni aucune trace de chemin, qui n'est peuplé que par de nombreux jaguars et d'immenses trou-[p. lxj]peaux de cerfs, d'autruches (1), de chevaux sauvages, et où les seuls hommes que j'aperçusse quelquefois dans le lointain, de l'autre côté du fleuve, étoient des insurgés espagnols, ennemis des Portugais.

Ce fut dans ce désert, sur les bords du ruisseau de Santa-Anna, que je faillis périr avec deux des hommes qui m'accompagnaient, empoisonné par quelques cuillerées du miel de la guêpe appelée *lecheguana.*

Dans les mois de décembre et de janvier, la chaleur avoit été excessive; le thermomètre indiquoit régulièrement de 24 à 29 degrés entre deux et cinq heures du soir, et j'avois fini par ne plus trouver de plantes. Cependant, vers les derniers jours de janvier, il tomba des pluies abondantes; les pâturages desséchés reverdirent avec une promptitude remarquable, et il y avoit déjà plusieurs jours que je revoyois des fleurs, quand j'entrai dans la province des Missions.

A mesure que je m'etois éloigné du Rio-Negro, j'avois observé moins de rapports entre la Flore de ce pays et celle de l'Europe; je recommençai à trouver un *Inga* et une *Mélastomée* aux catadupes de l'Uruguay; le saule, si commun autour de Monte-Video, avoit presque disparu, lorsque j'entrai dans la province des Missions; enfin quand j'y arrivai, il y avoit déjà quelque temps que je n'apercevois plus de plantes appartenant à d'autres genres de l'Europe; mais, en revanche, je revoyois plusieurs espèces que [p. lxij] j'avois déjà recueillies dans les *campos geraes* et même dans les parties élevées de la province des Mines. Si à présent je considère dans leur ensemble les plantes que j'ai récoltées entre l'embouchure du Rio-Negro, par le 33ᵉ degré et quelques minutes, et l'Ibicui, limite des Missions, par le 29ᵉ et quelques minutes, je trouverai que, sur 295 espèces, il y en a 21 qui n'appartiennent point à des familles de notre Flore française, savoir: deux *Calycérées,* deux *Palmiers,* deux *Bignonées,* deux *Malpighiées,* deux *Ménispermées,* deux *Sapindacées,* deux *Melastomées,* une *Nyctaginée,* un *Cissus,* trois *Commélinées,* un *Turnera,* et une *Gesneriée.*

On sait que les Missions, dites du Paraguay, se composoient de trente bourgades, dont vingt-trois situées entre le Paranna et l'Uruguay, et les

(1) Les Brasiliens des provinces de Minas-Geraes, Goyaz, etc., leur donnent le nom d'*ema,* emprunté de quelque idiome des Indes orientales. Les habitans de la province de Rio-Grande les désignent par le mot portugais et espagnol *avestrus.* Les Guaranis les connoissent sous celui de *chuni* et non *churi.* Quant au mot *nandu,* que les naturalistes ont consacré, il est peu usité parmi ces Indiens, quoiqu'il se trouve dans le dictionnaire des jésuites; cependant les Guaranis se servent du mot *nandua* qui signifie grand plumet.

sept autres sur la rive gauche de ce dernier fleuve. Les premières ont été réduites en cendres pendant la guerre désastreuse qu'Artigas a faite aux Portugais et à ses propres concitoyens (1) ; les autres, dont les Brasiliens avoient fait la conquête en 1801, sont les seules qui subsistent encore ; elles portent actuellement le nom de Province des Missions, et ce sont elles que j'ai visitées.

Les traditions qui se conservent encore dans cette belle contrée et les ruines qui la couvrent prouvent assez qu'on a peint sans exagération (2) le bonheur dont elle jouit autrefois. Ce n'est point en intelligence que les Indiens le cèdent aux hommes de notre race ; mais, quelle que puisse être leur éducation, ils restent sans prévoyance (3) ; et de ce défaut dérivent tous ceux qui les caractérisent. Le gouvernement auquel les Guaranis obéirent jusqu'en 1768, absurde sans doute pour des hommes de notre race, étoit basé sur [p. lxiij] une profonde connoissance des Indiens. Des hommes qui, comme les enfans, ne songent point au lendemain, ne sauroient parcourir sans guide la carrière de la civilisation, puisque la civilisation est fondée toute entière sur l'idée de l'avenir. Les Guaranis vécurent jadis dans une tutelle dont l'expérience a prouvé la nécessité, et elle ne pouvoit manquer d'être paternelle, parce que l'intérêt des tuteurs, d'accord avec leur honneur et leur devoir, étoit inséparable de celui des pupilles. Depuis 1768, les Guaranis furent livrés à des hommes qui ne virent en eux que les instrumens d'une fortune rapide ; le pays s'appauvrit bientôt et a fini par tomber dans une entière décadence. Les Portugais traitèrent les Guaranis plus mal encore que n'avoient fait les Espagnols. Le roi prenoit aux Indiens un intérêt touchant (4) ; mais son ministère sembloit avoir oublié que la province des Missions faisoit partie de la monarchie portugaise, et il la laissa ruiner par des employés subalternes. En 1768, la population des sept bourgades, aujourd'hui portugaises, s'élevoit à 30,000 habitans ; lorsqu'en 1801, les Espagnols se retirèrent, ils y laissèrent encore 14,000 ames ; en 1814, il n'y en avoit déjà plus que 6395 (5) ; enfin j'assistai moi-même au recensement qui se fit en 1821, et, dans toute la province, il ne se trouva qu'une population indienne de 3000 individus. On a enlevé aux Guaranis leurs meilleurs pâturages ; leurs bestiaux ont été dévorés ou conduits dans les habitations portugaises ; les bourgades tombent en ruines ; ces temples qui étonnent le voyageur ont été dépouillés et ne sont plus entretenus ; à peine quelques vieillards conservent-ils une tradition des arts et des métiers, et j'ai vu des infortunés que la faim dévoroit sur une terre qui leur appartient [p. lxiv] et qui produit chaque année deux récoltes. En un mot, la province des Missions, naguère si florissante, offre aujourd'hui le tableau de toutes les misères qui affligent notre espèce, et dans peu l'on y cherchera vainement des Indiens (6).

(1) Plusieurs ont été brûlées par le maréchal portugais Chagas Santos, les autres par les habitans du Paraguay proprement dit et par les Indiens eux-mêmes.

(2) Voyez Montesquieu, Raynal, Châteaubriand, etc.

(3) A peine pourroit-on citer quelques rares exceptions.

(4) Témoin la recommandation qu'il fit au colonel Paulete lorsqu'il le nomma commandant de la province des Missions, peu de temps avant la révolution du Portugal.

(5) Voyez l'excellent ouvrage intitulé *Annaes da Provincia de S.-Pedro*, par *Jose Feliciano Fernandès Pinheiro*.

(6) Ce que je dis ici des Missions ne s'accorde pas entièrement avec les opinions de D. Félix d'Azzara. Mais cet écrivain qui mérite les plus grands éloges comme

La partie la plus méridionale des Missions comprise entre l'Ibicui, l'Uruguay et le Camacuan présente d'excellens pâturages. Mais, à mesure qu'on s'éloigne de S.-Francisco-de-Borja (1), les bois deviennent plus communs, l'herbe perd de sa qualité, et à S.-Joaô et S.-Anjo, on est obligé, pour conserver le bétail et surtout les vaches, de leur donner du sel, comme dans le pays des Mines. En revanche, les terres du nord de la province sont très-propres à la culture. Sans être jamais fumées, elles donnent, comme je l'ai dit, deux récoltes par an, et produisent, avec une abondance égale, le froment, le coton, le maïs, le riz, les haricots, le manhioc, les melons, les courges, les melons d'eau, et en général les légumes et les fruits de l'Europe. En choisissant les endroits les mieux abrités, on peut même planter la canne à sucre avec quelque succès.

Principalement dans la partie septentrionale, l'ensemble de la végétation a beaucoup de rapport avec celle du district de Curitiba qui n'est guère éloigné des Missions que de deux degrés vers le nord. Il y a cependant cette différence qu'on ne voit point de bois d'*Araucaria* dans cette dernière province.

Je traversai le Serra-de-S.-Xavier qui n'est que la conti[p. lxv]nuation et presque l'extrémité de la grande cordillière, et je me retrouvai bientôt dans la province de Rio-Grande.

On étoit alors au mois d'avril, je ne voyois plus d'insectes, ni de plantes en fleur, et j'étois sans cesse contrarié par des pluies abondantes et par le passage des rivières. Depuis que j'étois sorti de la province de Sainte-Catherine, j'avois fait environ six cents lieues, et j'avois parcouru un pays coupé de rivières nombreuses; une partie de ce pays est riche et florissante, et cependant je n'avois pas vu un seul pont, quelquefois même je n'avois trouvé aucune pirogue sur le bord des rivières. Quand cela arrive, les habitans du pays prennent un cuir écru, ils en nouent les quatre coins, et en forment ainsi une sorte de barque arrondie (*pelota*), à laquelle ils attachent une courroie. Celui qui veut traverser l'eau, s'assied dans cette espèce de pirogue, et reste immobile pendant qu'un nageur, tenant la courroie entre ses dents, la tire jusqu'à ce qu'il soit parvenu à l'autre rive. J'ai fait transporter de cette manière un bagage souvent fort pesant; mais il est aisé de concevoir que le naturaliste ne peut sans inquiétude se voir forcé d'aventurer ainsi le fruit d'un long et pénible travail.

Arrivé à la ville de Rio-Pardo, je m'embarquai sur le Jacuy (2), et, après quelques jours de navigation, je me retrouvai, au bout de près d'un an de voyage, à Porto-Alegre (3).

N'ayant trouvé aucun moyen de transport par terre, je me décidai à m'embarquer pour Rio-Grande, et là pour Rio-de-Janeiro.

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observateur et comme peintre de mœurs, étoit imbu de quelques-uns des préjugés que les Espagnols apportoient trop souvent en Amérique, et il s'est mis en contradiction avec lui-même, lorsqu'il a parlé des Guaranis. Il a été au reste victorieusement réfuté par un historien ami de son pays, le D. Funes, dans son *Ensaijo de la Historia civil del Paraguay*, etc.

(1) Ou simplement S.-Borja.

(2) La rivière des Jacus (*Penelope*).

(3) Sans les recommandations que m'avoit données M. le comte da Figuera, gouverneur de la province de Rio-Grande, et les facilités de tout genre qu'il m'avoit accordées, il m'eût été impossible d'achever ce voyage.

Les trois mâts peuvent remonter jusqu'à Porto-Allegre, et l'on voit constamment plus de cinquante bâtimens de diverses grandeurs [p. lxvj] dans le port de cette ville. Cependant la navigation du lac dos Pathos est loin d'être sans danger; des vents terribles s'y font sentir; on n'y trouve d'abri que sur deux points différens; enfin ses eaux se répandant sur une grande surface, ne laissent pour le passage des navires qu'un canal fort étroit, et l'on n'a pas même eu le soin de l'indiquer par des balises.

La barre mobile de Rio-Grande est plus dangereuse encore, et, malgré les précautions que l'on a prises, les naufrages y sont encore fréquens.

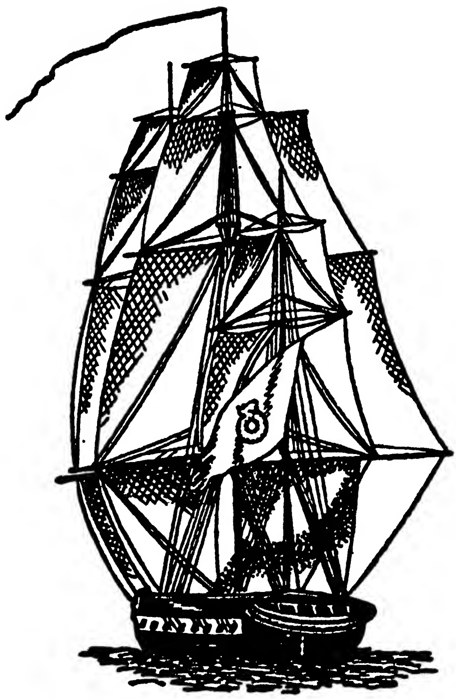
J'arrivai à Rio-de-Janeiro sans accident; mais il me restoit à aller chercher à Saint-Paul les collections que j'y avois laissées. Voulant rendre ce dernier voyage aussi utile qu'il dépendoit de moi, je me décidai à passer par la province des Mines. Je partis de Rio-de-Janeiro à la fin de janvier 1822; je montai une seconde fois la Serra-Negra; je revis Barbacena et S.-Joaô-del-Rey; je gravis sur deux hautes montagnes que je ne connoissois pas encore, celles d'Ibitipoca et de Juruoca; je visitai le pic du Papagayo où aucun habitant n'étoit monté depuis un grand nombre d'années; et, malgré le peu de temps que je donnai à ces excursions, elles me procurèrent encore des récoltes abondantes; ce qui prouve que mes recherches de dix-huit mois (1) dans la province des Mines étoient loin d'en avoir épuisé les richesses. Je passai par la ville de Santa-Maria-de-Baependy (2), que ses tabacs ont rendue fameuse; je revis dans ses environs des bois d'*Araucaria;* je traversai avec beaucoup de peine la grande chaîne occidentale ou la Serra-da-Mantiqueira, et je me trouvai dans la province de Saint-Paul.

Dans un espace d'environ cinquante lieues, le pays qui s'étend sur la route de Rio-de-Janeiro à Saint-Paul, no'offre que des mon-[p. lxvij]tagnes. Vers Lorena, l'on entre dans un bassin formé par la Serra-da-Mantiqueira et la grande cordillière maritime; et le terrain devient plus uni peut-être que dans tout le reste du milieu du Brésil. La végétation de Rio-de-Janeiro se retrouve, à quelques différences près, dans toute la partie montagneuse de la route, et se prolonge même douze lieues plus loin. Mais, vers Pindamonhonga, elle change presque tout à coup, et en même temps elle présente des différences assez sensibles avec celles des Mines et des Campos geraes. On peut promettre surtout les plus belles moissons de plantes à ceux qui pourront parcourir, dans toutes les saisons, les marais voisins de Thaubatè et de Mugy-das-Cruzes.

Je m'embarquai pour l'Europe au commencement de juin 1822, et j'ai eu le bonheur de préserver de tous les accidens les collections zoologiques et botaniques qui ont été le fruit de mes voyages. J'ai rapporté au Muséum de Paris deux mille cinq oiseaux, seize mille insectes, cent vingt-neuf quadrupèdes, trente-cinq reptiles, cinquante-huit poissons, quelques coquilles, quelques minéraux, etc. etc. Le nombre des plantes que j'ai recueillies s'élève à environ sept mille; je les ai toutes analysées sur les lieux-mêmes, et me suis principalement attaché à la dissection des parties dont la connoissance répand le plus de lumières sur les rapports naturels. Je m'estimerai heureux si je puis ne pas rester inutile à la science dont l'étude m'a procuré tant de fois de si douces jouissances.

(1) Quinze mois lors de mon premier voyage, et trois mois pour me rendre ensuite à Goyaz.

(2) Ou simplement Baependy.



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GOETHE'S BOTANY

Goethe's Garden House ("Gartenhaus am Stern"), after a drawing by Georg Melchior Kraus, from Neubert (1919): "Goethe und sein Kreis," Leipzig.

GOETHE'S BOTANY

The METAMORPHOSIS *of* PLANTS (1790)

and

TOBLER'S ODE *to* NATURE (1782)

With an introduction and translations

by

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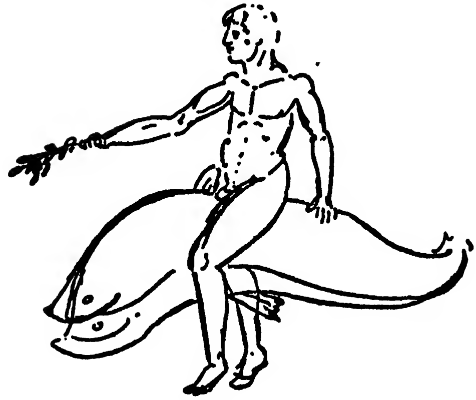

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Introduction[1]: — The botanist who attempts to study GOETHE's scientific work, finds himself dealing merely with one facet of a mental life unexampled in its many-sidedness. This one facet is so completely integrated with GOETHE's general productivity, that it cannot be understood except in connexion with the whole; but to see it thus in perspective demands an acquaintance not only with his own vast output of writings, letters, and recorded speech, but also with the immense corpus of GOETHE scholarship. This can scarcely be compassed by any man of science outside Germany.[2] Another difficulty with which the student of GOETHE's botany is faced at the outset, is that those scholars who have the fullest and most critical knowledge of his writings, differ radically in their estimate of his science, both in its relation to his work in general, and when considered in itself. At one

1. Throughout this Introduction the references to GOETHE's writings are given either from GOETHE, J. W. VON (1887 etc.): *Werke herausgegeben im Auftrage der Grossherzogin* SOPHIE VON SACHSEN, Weimar (cited here as Sophien-Ausgabe), or from TROLL, W. (1926): *Goethes Morphologische Schriften*, Jena (cited here as TROLL ed.; when, however, the reference is not to GOETHE's writings, but to TROLL's own introductory matter, the book is cited as TROLL, W. (1926)); or from the German part of GOETHE, J. W. VON (1831): *Versuch über die Metamorphose der Pflanzen. Übersetzt von* F. SORET, *nebst geschichtlichen Nachträgen*. Stuttgart (cited here as SORET ed.).

2. The references to the literature in the present Introduction have been limited by the inaccessibility of modern German work under the present conditions; I have not, for instance, been able to see SCHMIDT, G. (1940): *Goethe und die Naturwissenschaften*, pp. 618, Halle. To this bibliographical work, and to other titles, Dr. VERDOORN has kindly called my attention.

extreme we have authorities, such as J. G. ROBERTSON, who speaks with regret of the large share that science took in GOETHE's activities, and who voices the doubt whether his scientific interests "were not as real a crime against the majesty of his poetic genius as his immersion in the routine of state government"[3]; and Sir CHARLES SHERRINGTON, who remarked in a recent lecture: "Were it not for GOETHE's poetry, surely it is true to say we should not trouble about his science[4]". At the other end of the scale stands W. TROLL, who maintains, in a fully reasoned study of GOETHE's morphology, that the centre and focal point of his whole mental life is to be sought in his scientific writings[5]. We meet with the same conflict of opinion when the value of GOETHE's scientific work is assessed in itself, rather than in relation to his general output. SHERRINGTON, for instance, dismisses the metamorphosis idea as "no part of botany today", and adds that "GOETHE's view has gone the way of unsupported theories[6]"; on the other hand, TROLL—a botanist—ascribes to him the credit of having actually founded the science of morphology, the name of which he invented[7].

GOETHE himself was very far from considering his work in natural science as a mere side issue of his career as a poet. In old age, when reviewing his past, he declared that a great part of his life had been devoted to science, not only with inclination and with passion, but also with consistent effort; and he definitely claimed to be estimated seriously as a scientific worker[8]. Whether, with ROBERTSON, we should regard GOETHE's science as a grievous lapse, or, with TROLL, as one of the fertilising sources of his creative life, or whether a somewhat different type of appraisement is needed, will become apparent after we have reviewed the botanical aspect of his work, and the tendencies of his thought in biological matters.

GOETHE's childhood and youth were passed in towns, and it was not until he went to Weimar that vegetation came prominently under his eye; for there he found himself in the midst of fields and gardens, while hunting —a favourite pastime of the court—led him into the Thuringian forests. His responsible concern for everything local made him interest himself in the technique of forestry, which had been brought to a high pitch in the duchy. Moreover, owing to the Duke's amicable relations with his neighbours, even those forests which lay outside his boundaries were freely open to GOETHE. In this woodland country, which he came to know intimately, he made acquaintance with the herbalists to whom the apothecaries in the towns owed their supplies. These herbalists made all kinds of medicinal extracts, handing on their secret recipes from father to son. It was under their auspices that he learned to know, in particular, the different kinds of gentian, which were valued for the curative properties of the root; this was

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3. ROBERTSON, J. G. (1932): *The Life and Work of Goethe. 1749-1832.* London. pp. 312 and 97.

4. SHERRINGTON, C. (1942): *Goethe on Nature and on Science.* Cambridge, England; p. 23.

5. TROLL, W. (1926): *l.c.*, p. 5.

6. SHERRINGTON, C. (1942): *l.c.*, p. 21.

7. TROLL, W. (1926): *l.c.*, p. 7.

8. SORET ed.: *Nachträge und Zusätze*, I. *Der Verfasser theilt die Geschichte seiner botanischen Studien mit.* Pp. 107-63 (German and French version). Our knowledge of GOETHE's botanical history is largely derived from this piece of autobiography, which is to be found also in TROLL ed., pp. 187-209.

the first genus in which he studied specific distinctions. In retrospect GOETHE took pleasure in the analogy between his personal botanical history, and the history of botany in general; for his interest was first aroused by practical considerations, and it was only gradually that he came to be attracted by the subject in its theoretical aspect. GOETHE'S botanical tastes were stimulated especially by contact with a remarkable family—the DIETRICHS of Ziegenhain[9]—amongst whom, through a series of generations, a passion for botany asserted itself again and again. In 1688 a certain SALOMO DIETRICH, an exile from Bohemia for religion's sake, had fled to Thuringia, where he took a farm. In 1711 a son ADAM was born to him. ADAM succeeded his father in the farm, and one of his undertakings was to send weekly supplies of plants, for botanical purposes, to the University of Jena. He became well known as the Ziegenhain "Botanicus"; he treasured a letter written to him by LINNAEUS with his own hand—a document which he honoured as a patent of botanical nobility. Love of plant study extended to the fourth generation from ADAM DIETRICH; his great-grandson, A. W. S. DIETRICH, made and sold herbaria, and trained his wife, a village girl of Saxony, in all the necessary technique. Though not a DIETRICH by birth, she proved to have a supreme flair for field work, and she is remembered for the adventurous and solitary years she spent in North Australia, collecting for GODEFFROY; she lived into the last decade of the nineteenth century. The member of the family, who was specially associated with GOETHE, was AMALIE'S uncle by marriage, F. GOTTLIEB DIETRICH, born in 1768. GOETHE met him in the seventeen-eighties, and was so much pleased with his knowledge of Linnean botany, and his ecstatic happiness in it, that he took him as a companion when he went to Carlsbad for a cure. On the journey, GOTTLIEB searched for plants, bringing them to GOETHE'S travelling carriage, while proclaiming their Latin names like a herald. When GOETHE had settled at the spa, GOTTLIEB was away among the mountains by sunrise, hunting for flowers, and was able to bring the spoils to GOETHE before he had finished his morning draught of the waters.

For a time, GOETHE remained wholly devoted to the Linnean system, giving himself up to it with absolute confidence. As books which he was constantly studying, he names LINNAEUS' *Fundamenta botanica, Termini botanici,* and *Elementa botanica,* and also JOHANN GESSNER'S *Dissertationes.* The latter work, which explained the principles of LINNAEUS, was published under his aegis[10]. Even when GOETHE had lived through the first ardour of enthusiasm for studies of this type, and had published refutations of certain erroneous views held by LINNAEUS[11], he still retained a reverence for the master himself, but the nature of this reverence has sometimes been

9. BISCHOFF, C. (1931): *The Hard Road: The Life Story of Amalie Dietrich.* Translated by A. LIDDELL GEDDIE. London. (C. BISCHOFF is the great-great-granddaughter of ADAM DIETRICH, on whom *see* BENEDIKT, E. (1945): *Goethe und Linné.* Svenska Linné-Sällskapets Årsskrift, 28, pp. 49-54; this paper appeared after the present Introduction was in print.)

10. The title is GESNER (GESSNER), J. (1743): *Dissertationes physicae de vegetabilibus. Quarum prior partium vegetationis structuram, differentias et usus, posterior vero partium fructificationis structuram differentias, ac usus sistit. In quibus elementa botanica Celeb. Linnaei dilucide explicantur.* (Printed with LINNAEUS, C. (1743): *Oratio de necessitate peregrinationum intra patriam.* Lugduni Batavorum.)

11. *See* p. 76.

misunderstood by GOETHE students, and its degree exaggerated, on the strength of a sentence in a letter to ZELTER, written on November 7, 1816[12]. He says, speaking of LINNAEUS, "Except SHAKESPEARE and SPINOZA, I am not aware that any man of the past has had such an influence upon me." This is, at first sight, a startling remark, for it is impossible to believe that a man of GOETHE's mental calibre could have ranked LINNAEUS actually with either SHAKESPEARE or SPINOZA. A careful reading of this and preceding letters sets the matter, however, in a different light; for it becomes clear that GOETHE's words do not relate to these three men, appraised in themselves, but merely in their effect upon his own personal development, an effect depending largely on his individual circumstances. It is important to notice that, in the letter just cited, he avows that, though he has learned an infinite amount from LINNAEUS, what he has learned has not been botany. In the previous month[13] he had told ZELTER that a return to the study of LINNAEUS, many years after he first came to know his work, had brought him to recognise that he has used the Swedish master in symbolic fashion only; that is to say, he has sought to transfer LINNAEUS' method and mode of treatment to other subjects, thus gaining an efficient mental instrument. We have to remember that GOETHE had undergone no explicit training in scientific discipline, and that he apparently knew little about pre-Linnean plant study. His tendency was to regard the whole corpus of systematically-developed biological thought as being the outcome of the genius of LINNAEUS alone. This attitude, which was very common in those days, was condemned by BATSCH, a botanist with whom GOETHE was acquainted[14]. BATSCH greatly admired LINNAEUS, but, in a book published in 1787, he protested against the injustice of exalting him at the expense of the many other writers who, in the eighteenth century, had promoted the knowledge of plants[15]. We can completely understand GOETHE's share in this overestimate, when we consider his intellectual history. When he first read LINNAEUS' writings, they supplied what was his crying need at that stage—an objective and scientifically methodical approach to botany; none of his previous studies in literature, law, or art, had been able to do him this particular service.

Despite the fervour with which, in his earlier pursuit of plant science, he had followed LINNAEUS, nothing could make detailed systematic botany really native to GOETHE. Although, stimulated by GOTTLIEB DIETRICH, he learned something of the application of the Linnean system in the field, he came gradually to the conclusion that the minute analysis and counting of the floral parts, which it involved, were not in his line: "Trennen und Zählen lag nicht in meiner Natur". At that date, when optical aids were not as advanced as they are today, a disinclination for the study of small objects must often have arisen simply out of visual difficulties; but, in GOETHE's case, the reaction against such occupations seems to have been

12. *Goethes Briefe*. Sophien-Ausgabe, Abth. IV, Bd. 27, p. 219.
13. *Goethes Briefe, l.c.*, p. 200, Oct. 14, 1816.
14. For an account of BATSCH, and his relations with GOETHE, *see* HANSEN, A. (1907): *Goethes Metamorphose der Pflanzen.* (2 pts. Text and Plates). Giessen. Chapter VII.
15. BATSCH, A. J. G. C. (1787): *Versuch einer Anleitung zur Kenntniss und Geschichte der Pflanzen.* Halle; *see* p. 8.

primarily a deep-seated mental one. He himself contrasts the way of studying Nature which consists in proceeding analytically into the individual particulars, with that which consists in following the clue holistically through breadth and height[16]; it was to the latter method that his limitations as well as his powers inclined him. He realised that the devotion of a lifetime, and aptitudes of a special order, were necessary for comprehensive and intensive systematic work, and he held that for him there was another way, more in keeping with the rest of his course through life, namely the contemplative study of the phenomena of change and mutation in the organic world — phenomena which had created a deep impression upon his mind[17]. In process of time the systematic aspect of botany seems, indeed, to have lost its appeal for him altogether. Late in life he wrote that Nature has no system, but that "she is the transition from an unknown centre to a limit which is not discernible", and that "Natural System" is thus a contradiction in terms[18]. Even in the earlier period, when GOETHE's ideas about biology were in their plastic phase, he was not alone in feeling a certain dissatisfaction with the way in which systematics, in the Linnean sense, had come to dominate botany. HEDWIG, a writer with whose work GOETHE was acquainted, pointed out in 1781 that plant study had been too much concerned with the examination of new material from all parts of the world, and with detailed descriptive work, to give much consideration to the "inner economy" of the plant on which all depends[19]. It was this "inner economy", and the morphological signs through which it expresses itself externally, on which GOETHE's interest was finally concentrated. He could not however have thrown light upon this aspect of the subject but for his earlier apprenticeship in looking closely at plants for the purpose of detecting their taxonomic marks. His practice in handling them impressed him with the contrast between the inevitable rigidity of the classificatory system, and the versatility of the organs themselves. Certain plants, for instance, came to his notice in which the same stem bore a *crescendo* series of leaves, of which the earliest were entire, and the next lobed, while an ultimate, almost compound-pinnate shape was succeeded by a *diminuendo* series of simplified forms, gradually reducing to small scales, and thence to nothing. The systematic botany of the period paid little attention to the plasticity of leaf structures, and GOETHE was unable at first to find any clue to the part which these transformations played in the general scheme of things. It was his journey into Italy, with the sight which it yielded him of a flora, both wild and cultivated, which was rich to a degree undreamed of in his more northerly home, and to which his mind was not deadened by familiarity, that finally set in motion a train of ideas which was to dominate his conception of the plant world for the rest of his life. A glimpse of the southern vegetation which so delighted him is revealed in his sketch of fig tree and maize.

One of his crucial experiences was his visit to the botanical garden at

16. *Probleme,* TROLL ed., p. 221.
17. *Entstehen des Aufsatzes über Metamorphose der Pflanzen.* TROLL ed., p. 208.
18. *Probleme,* TROLL ed., p. 221.
19. HEDWIG, J. (1781): *Vom waren Ursprunge der mänlichen Begat'ungswerkzeuge der Pflanzen.* Leipziger Mag. zur Naturkunde, Math. und Oecon. (Leipzig und Dessau), pt. III, pp. 257-319; *see* p. 299.

Padua. Here he saw a palm, *Chamaerops humilis* L., from which he collected a series of leaves, ranging from early lanceolate forms, up to the mature fan, and then, by a sudden transition, to the spathe enclosing the inflorescence. These leaves he carefully preserved, and, thirty years later, he confessed to still regarding them as fetiches, because of the way in which they had arrested his attention at a critical juncture. The botanical garden at Padua has the longest history of any in Europe, having been founded in 1542, and GOETHE's palm, which still flourishes,[20] is said to date from as long ago as 1584. Though his suite of palm leaves set GOETHE pondering, it did not give him immediate illumination; this came after, in April 1786, he reached Sicily—the ultimate goal of his travels—and during his return journey to Rome[21]. The conviction of the original identity (ursprüngliche Identität) of all the members of the plant then became explicit in his mind. The *Versuch die Metamorphose der Pflanzen zu erklären*[22], published in 1790—the year in which GOETHE was forty-one—is the reasoned outcome of the meditations which began to take shape beside the palm tree at Padua. GOETHE realised, in the first place, the identity of the various forms of foliage leaf and bract, and then extended this conception to the parts of the flower. It was by no means the first time that ideas of this kind had occurred to botanists; to equate at least the outer members of the flower with leaves, has, indeed, always been natural to any acute observer. In the fourth century before CHRIST, THEOPHRASTUS had used the word 'leaf' (τὸ φύλλον) for the corolla[23]. Some 2000 years later, NEHEMIAH GREW[24] gave excellent anatomical reasons for considering sepals and petals as equivalent to foliage leaves, and—as regards the sepals—he called in also the evidence of abnormal forms. GREW's contemporary, MARCELLO MALPIGHI, again, described and figured the intermediates which may occur between petals and stamens in the rose[25]. These seventeenth-century anticipations were somewhat fragmentary, but, in 1768, more than twenty years before the publication of the *Metamorphose*, C. F. WOLFF[26] made a remarkably complete though brief statement of views closely related to those which GOETHE afterwards developed. WOLFF wrote that in some plants it is obvious that the calyx is a collection of relatively small and imperfect leaves, and that the pericarp is no less evidently composed of true leaves, which are, however, united. Petals and stamens, also, are *folia modificata*. Transitions between sepals and petals can be observed, and, in flowers with numerous stamens, these often degenerate into petals[27]. GOETHE was un-

20. Information by letter from Professor G. GOLA, Sept. 14, 1945.
21. TROLL, W. (1926): *l.c.*, p. 52.
22. Throughout this Introduction, this work, of which a translation follows (pp. 88-115), will be cited as *Metamorphose*.
23. THEOPHRASTUS (1916): *Enquiry into Plants*. Translated by Sir A. HORT, London. I.xiii.2; vol. I, p. 90.
24. GREW, N. (1672): *The Anatomy of Vegetables Begun*. London; *see* pp. 129-32, etc., discussed in ARBER, A. (1942): *Nehemiah Grew (1641-1712) and Marcello Malpighi (1628-1694)*. Isis, vol. 34, pp. 7-16; *see* p. 12.
25. MALPIGHI, M. (1675): *Anatome Plantarum*. London; p. 46 and pl. 28, fig. 160, "mixtura staminis et folii."
26. For details of WOLFF's career, and a critical appreciation of his work, *see* KIRCHHOFF, A. (1867): *Die Idee der Pflanzen-Metamorphose bei Wolff und bei Goethe*. Berlin.
27. WOLFF, C. F. (1768): *De formatione intestinorum*. Novi Commentarii Acad. Scientarum Imperialis Petropolitanae, vol. 12, pp. 403-507; *see* pp. 404-6.

acquainted with WOLFF's work when he wrote the *Metamorphose;* at that time, indeed, his knowledge of the relevant botanical literature was far from complete. He had no conception of the modern code according to which the scientist is under an obligation to read all that has been published on any problem before putting forward a solution of it as being his own. On the contrary, GOETHE undoubtedly felt himself entitled to full credit for any notions, which he had himself evolved without conscious borrowing, even if others happened to have expressed them before. He maintained[28] that the savant should use his predecessors' work without indicating his sources at every turn, although he ought to express his gratitude to those benefactors who have unlocked the world for him. Despite GOETHE's keen desire to be regarded by professional workers as a fellow scientist, the technique of his approach remained essentially that of the literary man, who is not expected to give a detailed enumeration of his sources in, for instance, a poem or a play. The *Metamorphose* must be judged, not as if it were a modern scientific treatise, but as a presentation of a nexus of ideas, much of the material for which was already in existence. These ideas GOETHE alone succeeded in developing into a unified organic whole, by adjusting them to the living framework of his thought, and thus creating one of the minor classics of botany[29]. It has been claimed that, on his Italian journey, his passion for the scientific study of nature closed with and worsted his creative instinct[30]; but such a view cannot be accepted by those who hold that creative insight can find its play in morphology as well as in poetry. It is this very quality which has given GOETHE's botanical work its permanent life.

GOETHE met with some difficulty in connexion with the appearance of the *Metamorphose* in book form[31]. His regular publisher, GOESCHEN, declined it, but ETTINGER of Gotha produced it in 1790; as GOETHE himself notes with satisfaction, it was beautifully printed in Roman type. The title-page is shown in facsimile on p. 88. A reprint, not identical in format, was issued by ETTINGER in the same year[32]. On casually turning over the pages of the *Metamorphose,* one may get a somewhat *staccato* impression, since it consists of a series of 123 short numbered paragraphs, which in the first edition were spaced rather far apart; these paragraphs are grouped into eighteen Parts. The sense, however, tends to run on without a break even from Part to Part. Extreme examples are the transition from the end of Part III to the beginning of Part IV, which opens, "This (dieses) seems still more probable"—"This" being inexplicable without reference to

28. *Meteore des literarischen Himmels. Plagiat.* Sophien-Ausgabe, Abt. II, Bd. 11, p. 252.

29. For a detailed review of the history and influence of GOETHE's ideas, *see* WIGAND, A. (1846): *Kritik und Geschichte der Lehre von der Metamorphose der Pflanze.* Leipzig. In reading this book, allowance must be made for its date, and for the fact that WIGAND's turn of mind was laborious rather than illuminating. Some criticisms of WIGAND's work will be found in KIRCHHOFF, A. (1867): *l.c.*

30. BUTLER, E. M. (1935): *The Tyranny of Greece over Germany.* Cambridge, England; p. 113.

31. *Schicksal der Handschrift.* TROLL ed., pp. 211-2.

32. On the editions *see* HANSEN, A. (1907): *l.c.,* p. IX. Those who wish for a modern reprint will find the one in TROLL ed. valuable, as it is beautifully illustrated with early, and also with new, figures.

Part III; or the transition from the end of Part X to the opening of Part XI, which begins, "On the contrary", (Dagegen), thus carrying on the argument continuously from the preceding Part. Paragraph 92, also, may not be understood unless it is recognised that it is an abstract of the conclusions of GAERTNER, to which reference has been made in the previous paragraph.

The word *Metamorphose,* in the title of GOETHE's book, was not altogether a happy one for his purpose. From classical times it had had poetical associations, which might well lead the reader to expect a work of fancy rather than of science, especially when the author was already famous for his imaginative writing. GOETHE himself complains that, on telling one of his friends that he had published a little volume upon the metamorphosis of plants, the friend expressed his delight in the prospect of enjoying GOETHE's charming description in the Ovidian manner of narcissus, hyacinth and daphne[33]. There was also a certain confusion inseparable from the term metamorphosis, because it had been not only used in describing the life history of insects, but had, in addition, been taken over by LINNAEUS into botany, in a sense different from that of GOETHE; LINNAEUS employs it in connexion with the change from the vegetative to the flowering phase, which he seems to have regarded as analogous to the change from the caterpillar stage to that of the perfect insect[34].

Apart from these questions of accepted usage, the term metamorphosis was not in itself exactly applicable to the events with which GOETHE dealt. As JAEGER[35] pointed out in 1814, the expression cannot be more than symbolic, since we do not, as a rule, witness an actual process of transformation; to say that any organ, as we know it, has been "transformed", is thus merely a figure of speech. The term metamorphosis can only denote a change which we imagine happens in the formative force (Bildungskräfte), rather than anything detectable in the visible members, though it is from the observed differences in the visible members that we deduce the existence of this underlying metamorphosis. JAEGER's criticism is fully justified, and it is useful as stressing the elusiveness of the ideas in which GOETHE dealt, and the fact that even he himself did not always succeed in grasping them firmly.

The development of GOETHE's theory in his little book is on the whole so limpid in expression that commentary is seldom needed to make it fully intelligible today. The thread, upon which the whole exposition is strung, is the idea of metamorphosis in its two main aspects: *normal* or *progressive;* and *abnormal* or *retrograde.* Normal metamorphosis is the change seen in the successive types of lateral appendage, from the cotyledons, through the foliage leaves, and bracts, to the final reproductive goal in the fruit. In abnormal metamorphosis, on the other hand, there is, in the ascent towards

33. MARTINS, C. F. (1837): *Oeuvres d'histoire naturelle de Goethe, traduits et annotés par* CH. FR. MARTINS *avec un atlas in-folio contenant les planches originales de l'auteur, et enrichi de trois dessins et d'un texte explicatif sur la métamorphose des plantes par* P. J. F. TURPIN. *Paris. Destinée de l'opuscule imprimé,* p. 267. This discourse, which GOETHE called *Schicksal der Druckschrift,* took more than one form, and I have not found the passage cited except in MARTINS' translation.

34. LINNAEUS, C. (1767): *Systema Naturae.* Vol. 2, Editio Duodecima, Reformata. Holmiae; p. 8.

35. JAEGER, G. F. VON (1814): *Ueber die Missbildungen der Gewächse.* Stuttgart; p. 252.

reproduction, a back-sliding to a level which has already been passed, as, for example, when a stamen is developed in petaloid form. It should be noticed that GOETHE uses the term 'leaf' (Blatt) for the member which undergoes successive changes, appearing in the guise of one lateral appendage after another[36]. GOETHE himself recognised that this terminology is unsatisfactory, since the word 'leaf' is inseparably associated in daily usage with the foliage leaf, whereas, on his view, the foliage leaf has no more claim to be itself the typical 'leaf' than has, for instance, the cotyledon or the stamen. A generalised term, such as 'phyllome,' which was given currency in the nineteenth century especially by NAEGELI[37], meets the case better than 'leaf', since it is not hampered by special associations. GOETHE's recognition that neither the foliage leaf, nor any other appendage, is in itself the 'type' leaf, is perhaps the most original feature of his theory. It represents an advance beyond the position adopted by WOLFF, who seems to have regarded the other appendages simply as modifications of the foliage leaf. This difference may be associated with a general difference between the outlooks of the two men; WOLFF was primarily a scientific observer, and GOETHE, primarily an intuitive thinker[38].

GOETHE was not satisfied merely to note the outward signs of metamorphosis; he wanted also to understand its mechanism. The theory at which he arrived was that the changes in the passage from cotyledons to reproductive appendages are due to the gradual elaboration and refinement of the sap as it travels from node to node. At GOETHE's date there were no means of developing such a theory in detail, but the view he tried to express may well be regarded as foreshadowing modern ideas upon the relation of chemistry and form[39]. It has also been suggested that the process of metamorphosis, as visualised by GOETHE, may be restated in twentieth-century terms by interpreting it on genic lines[40].

A notion upon which GOETHE laid much stress in the *Metamorphose* was that the annual plant shows six alternating stages of expansion and contraction. He considered that expansion took place in the passage from the cotyledons to the foliage leaves; the calyx to the corolla; and the sexual organs to the fruit. Contraction, on the other hand, occurred in the passage from the foliage leaves to the calyx; the corolla to the sexual organs; and the fruit to the seed[41]. The artificiality of this scheme is obvious, but GOETHE may have been dimly groping after a conception of periodic rhythm in the development of appendages at the growing apex.

Another hypothesis which GOETHE used in his interpretation of plant life, but which is out of accord with modern views, is that—derived from HEDWIG[42]—of the prime importance of the spiral vessels or tracheids

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36. *Metamorphose,* § 119.
37. NAEGELI, C. VON (1884): *Mechanisch-physiologische Theorie der Abstammungslehre.* München und Leipzig.
38. *Cf.* KIRCHHOFF, A., (1867): *l.c.,* pp. 28 and 31.
39. LAKON, G. (1921): *Goethes physiologische Erklärung der Pflanzenmetamorphose als moderne Hypothese von dem Einfluss der Ernährung auf Entwicklung und Gestaltung der Pflanze.* Beihefte zum Bot. Centralbl., Bd. 38, Abt. I, pp. 158-81.
40. HAYATA, B. (1921): *An Interpretation of Goethe's Blatt.* Icon. Plant. Formos. X, pp. 75-95. I know only the referat in Bot. Jahrb., vol. 57, 1922, Literaturbericht, pp. 47-8.
41. *Metamorphose,* § 73.
42. HEDWIG, J. (1781): *l.c.,* p. 308.

(Spiralgefässe)[43]. It is not surprising that almost magical qualities should have been ascribed to these elements in the early days of anatomy, for the crudest technique revealed them distinctly, and it was natural that their spring-like form should suggest peculiar powers. We cannot reproach the earlier writers with their over-emphasis on spiral vessels, when we recall the way in which, even today, the conspicuousness of xylem in stained sections leads botanists at times to treat it as if it were something with an independent identity of its own, merely embedded in the rest of the tissues, like the waterpipes in a building. GOETHE was so much intrigued by the ideas aroused by the spiral tracheids, that, after the *Metamorphose,* he carried his speculations on spiralness in general to a further point in an essay *Ueber die Spiral-Tendenz der Vegetation*[44].

The small amount of controversial matter to be found in the *Metamorphose* includes a disclaimer of the fanciful theory put forward by LINNAEUS under the name of *Prolepsis*[45] or Anticipation. LINNAEUS supposed that vegetative buds consisted of a succession of buds within buds, going on to the sixth generation; no doubt this was an offshoot from the doctrine of preformation[46], which had so widespread an influence in the eighteenth century. He accounted ingeniously for the occurrence of the reproductive phase by postulating that, when a bud produced a flower instead of a vegetative shoot, the six generations enfolded in the bud all came to light at once—future years being as it were, anticipated, and the leaves of successive years being transformed in their due order into bracts, calyx, corolla, stamens, and the pistil with its seeds. LINNAEUS also believed that he had hit upon the mechanism by which the plant achieves this metamorphosis; he supposed that the leafy shoot becomes changed into the flower by the conversion of the cortex into the calyx; the liber into the corolla; the wood into the stamens; and the pith into the pistil with its contents. GOETHE rightly demonstrated the futility of this attempt to relate floral parts to successive zones of tissue[47].

The theory embodied in the *Metamorphose* has had to face much opposition, part of which has been due to careless and often second-hand misinterpretation, but, apart from this, which can easily be remedied, a residue of genuine difficulty is left, due to certain inadequacies in the theory as GOETHE conceived it. The artistic economy of his exposition was achieved at the expense of deliberate and ruthless exclusions, which to some extent reduce the significance of the work. He limited his consideration, for instance, to the annual herb[48], paying very little attention to other life forms, and he specifically omitted monocotyledons in discussing seed-leaves[49].

43. *Metamorphose,* § 60.
44. Sophien-Ausgabe, Abt. II, Bd. 7, pp. 37-68. French translation in MARTINS, C. F. (1837): *l.c.,* pp. 329-33.
45. LINNAEUS, C. (1767): *l.c.,* p. 8; *see also* ULLMARK, H. (1760): *Prolepsis plantarum, in* LINNAEUS, C. (1764): *Amoenitates Academicae.* Lugduni Batavorum. Vol. 6, No. cxviii, pp. 324-41.
46. For GOETHE's attitude to preformation see *Der Inhalt bevorwortet,* p. 120, in *Zur Morphologie,* TROLL ed.
47. *Metamorphose,* § 111.
48. *Metamorphose,* § 6.
49. *Metamorphose,* § 17.

Within the plant itself, his interest scarcely extended beyond the lateral appendages of the stem, and the root he practically ignored. It is true that, in some notes not included in the *Metamorphose,* he spoke of the root as a leaf that absorbs moisture under the earth[50]. He did not, however, follow out this suggestion, and later in life he went so far as to ask how he could be expected to concern himself with such an organ as the root, which shows no ascending progress (Steigerung)[51]. Indeed, as TURPIN[52] pointed out long ago, GOETHE's treatise cannot be said to deal, as he claimed, with the metamorphosis of *plants,* since it is only the metamorphosis of the *appendicular organs* of the stem which comes within its purview. Such limitations of the scope of the work would have been entirely harmless if GOETHE had recognised that the problem, as he set it to himself, and consequently the solution which he proposed, were in their very nature incomplete, and represented, not a full morphological interpretation, but merely a single step towards such an interpretation. He did not, however, see the matter in this light, but he treated his theory, of which he was enamoured, as having the finality of a work of art, rather than the provisional character of a work of science. Though he lived for more than forty years after propounding his thesis, and remained deeply interested in it throughout that time, he was inclined to treat it as something achieved once and for all, rather than as a stepping-stone to further developments. He was prepared to amplify it, and offer additional evidence for it, but he did not feel the urge to leave it behind, as an outgrown phase in a continued progress. It was a defect of GOETHE's amateur pursuit of science that he was too much attached to his personal notions and never attained the professional's hard-earned capacity for seeing his own work in due proportion in the general stream of thought. He himself defended the amateur standpoint, on the ground that the non-professional, being free from the obligation to strive after completeness of knowledge, is better able to reach a height from which he may gain a broad view[53]. He failed, however, to realise that detailed knowledge, not limited to the worker's own special line, though it may seem of little value considered in itself, is yet essential as forming a framework of reference for general principles. He would not have sympathised with the artist who said that the best way to get a broad and generalised effects is, not to ignore the detail, but to paint it in, and afterwards to scrape it out remorselessly with the palette knife.

The confinement of GOETHE's interest to the lateral appendages of the stem was one of the effects of his amateur outlook. This limitation led him to consider the leaf as a primary member. He treated it as 'given', and therefore never attempted to ask the question, "What is the leaf?" This question would have seemed to him to fall outside the sphere of legitimate enquiry. It was characteristic of his approach to problems of thought that he drew a definite distinction between those problems which were suit-

50. Quoted in TROLL, W. (1926): *l.c.,* p. 52.
51. Sophien-Ausgabe. Abt. II, Bd. 6, *Zur Morphologie. Verfolg,* p. 331, *Unbillige Förderung.* 1824.
52. TURPIN, P. J. F. (1837): *Esquisse d'organographie végétale, . . . pour servir à prouver . . . la métamorphose des plantes de Goethe.* Paris et Genève; see p. 7.
53. TROLL ed.: *Der Verfasser teilt die Geschichte seiner botanischen Studien mit.* p. 197.

able for investigation, and others which should be quietly reverenced and left untouched[54]. If he had felt himself justified in trying to understand the nature of the leaf, he might have come to visualise this member, not merely in itself, but also in its relation to the plant as a whole; and he might then have realised that the shoot is a more fundamental unit of plant construction than the leaf, and that the leaf should be explained in terms not of itself but of the shoot. As it was, the leaf was not clearly seen in relation to the shoot until much later, when CASIMIR DE CANDOLLE[55], in the latter half of the nineteenth century, suggested that the leaf might be regarded as *a partial-shoot.* He supposed that the limited growth, and the dorsiventrality, of the leaf as compared with the shoot, might be interpreted as due to the atrophy of the apex and ventral face of the terminal meristematic cone. More recently, as a development of this view, the idea has been propounded that the leaf is *a partial-shoot, which shows an urge towards whole-shoot characters*[56]. It should be understood, however, that this modern version of the partial-shoot theory of the leaf, even if it be an advance on GOETHE's view, makes no claim to be a final morphological interpretation of the plant body. As a further step, an attempt has been made towards a parallel explanation for the root[57]. This attempt is, admittedly, most tentative, and no doubt some generalisation of a more inclusive character will eventually grow out of this sequence of opinions, absorbing and transcending them. Unfortunately, in the long period that has elapsed since DE CANDOLLE's theory was set forth, little notice has been taken of it by botanists, while, on the other hand, GOETHE's treatment of the leaf as an irreducible unit has remained permanently influential; this is partly, perhaps, because the suggestion that anything may be accepted as 'given', and therefore not to be questioned, often receives a ready welcome as a trouble-saving device. Even today, modern German morphology, of the school that sees all hope for the future in a return to GOETHE, takes as a postulate that the leaf is a 'Grundform', in no way derivable from any other member of the plant body[58]. This is indeed scarcely fair to GOETHE, since he himself had moments when —though sometimes in an inverted fashion—he made an approach towards the partial-shoot theory of the leaf. In one of his notes, after saying that "Alles ist Blatt," he suggests that the stem is a leaf that becomes radially symmetrical (Ein Blatt, das sich gleich ausdehnt)[59]. Again, he writes of compound leaves as "in reality branches, the buds of which cannot develop, since the common stalk is too frail"[60].

At the time when GOETHE published the *Metamorphose,* he intended

54. TROLL, W. (1926) : *l.c.,* p. 8. *See also* SAUNDERS, [T.] BAILEY (1893) : *The Maxims and Reflections of Goethe.* London. No. 577, p. 200.
55. CANDOLLE, C. DE (1868) : *Théorie de la Feuille.* Arch. Sci. phys. nat., Genève. Vol. 32, pp. 31-64.
56. ARBER, A. (1941) : *The Interpretation of Leaf and Root in the Angiosperms.* Biol. Rev., Cambridge, England, vol. 16, pp. 81-105. This paper includes a fuller account of the partial-shoot theory, and the evidence on which it is based, than can be given here.
57. *See* preceding footnote.
58. TROLL, W. (1938) : *Vergleichende Morphologie der höheren Pflanzen.* Berlin, Bd. 1, Teil 2, p. 957.
59. Quoted in TROLL, W. (1926) : *l.c.,* p. 52.
60. Sophien-Ausgabe, Abth. II, Bd. 13 (Nachträge zu Bd. 6-12), Nachträge zu Bd. 7. Paralipomena 130, p. 125.

eventually to produce, as a sequel, a more comprehensive account of the subject, fully illustrated. His commitments—literary, scientific, and administrative—increased, however, so rapidly, that the scheme was never fulfilled. It is at least arguable that this failure is not to be regretted. In its own small-scale *genre,* the *Metamorphose* is a finished work, and it is doubtful if any attempt to expand it, without a definite strengthening of the thread of theory that runs through it, would have been happy in its result; the book in its 1790 form was, in GEOFFROY SAINT-HILAIRE's phrase, "immédiatement complète"[61]. Though the larger work projected was never written, GOETHE continued all his life to amass material bearing on his theory of plant morphology. As well as the writings printed in his lifetime, all his extant notes on the subject have been retrieved and published with pious care[62], including even the scribbles with the aid of which he jotted down his ideas on plant form; an example of these "characteristischen Federstrichen" is reproduced on p. 118. Fragmentary as his notes are, they are still rich in suggestion for thinkers of the present day. Judging him by the *Metamorphose* alone, modern botanists have been liable to underestimate GOETHE's actual botanical knowledge. We have now learned, however, that he was not only active as a collector, but that the pictures which he got together with a view to illustrating his definitive work, bear witness to acute observation and a keen, if selective, insight. These drawings were made under his direction, and, in part, with his own hand. He had a number of them engraved, so that they would be ready when he required them; but one of the hindrances to the production of his intended book was that, when the copper-plates were wanted, they had been mislaid, and they do not seem to have been found during his lifetime[63]. In the present century many of GOETHE's figures have been brought to light and printed. One set of pictures is from a small portfolio dating from 1795[64], preserved in the GOETHE-Nationalmuseum at Weimar; it was published by HANSEN in 1907[65]. Another set, including drawings from a large portfolio of 1830 in the Weimar Bibliothek, has been exquisitely reproduced by SCHUSTER[66], with a full critical commentary, and some reconsideration of HANSEN's material. This corpus of botanical drawings, in which teratology is strongly represented, and which also includes beautiful studies of seedlings, shows that GOETHE was fully alive to those aspects of factual detail which bore upon subjects which interested him. One illustration, which is of special significance in connexion with GOETHE's morphology, shows the various forms of compound leaf met with in *Aegopodium podagraria* L. (goutweed)[67]. These coloured drawings were made by a professional artist on the basis of pencilled outlines, which SCHUSTER believes were GOETHE's own. GOETHE's attention is known to

61. GEOFFROY SAINT-HILAIRE (ÉTIENNE) (1831): *Sur des Écrits de Goethe lui donnant des droits au titre de savant naturaliste.* Ann. d. Sci. nat., T. 22, pp. 188-93; *see* p. 190.

62. *See* especially the Sophien-Ausgabe, and TROLL ed.

63. TROLL ed. *Nacharbeiten und Sammlungen,* p. 239.

64. SCHUSTER, J. (1924): *Goethe, die Metamorphose der Pflanzen mit dem Originalbildwerk.* Berlin. Pp. 116, 118, 121.

65. HANSEN, A. (1907): *l.c.*

66. SCHUSTER, J. (1924): *l.c.*

67. SCHUSTER, J. (1924): *l.c.,* pl. VII.

have been specially attracted by the foliage of this plant, for one of his notes[68] mentions its "remarkable *folia composita*", of which "the single leaflets are in part composite again, in part more or less indented, or completely simple"; and GOETHE records his intention of making a collection of them. His strong and wide-ranging artistic gift, shown, for instance, in the drawings on pp. 65, 116 and plate 25, was invaluable to him as a botanist. His preliminary sketch of an opening horse chestnut bud with its "calyx" of bracts is reproduced on p. 116. Another picture, which is of peculiar interest to students of GOETHE's botany, is that of a proliferating pink[69]. This delicate pencil outline is apparently by GOETHE himself, for in the summer of 1787 he found such a specimen in Italy, and mentioned that, since he had no means of preserving this marvellous form (Wundergestalt), he attempted an exact portrayal of it[70]. It was evidently a labour of love, for he wrote of the plant in question as embodying all his ideas, and giving him rapturous delight[71].

This rapturous delight seems to have been aroused in GOETHE's mind primarily by any fulfilment of his desire to resolve the antithesis between the Many and the One—a desire which is the keynote to the whole of his biological work. In this connexion the prose poem, *Die Natur,* reprinted here with a translation (pp. 121-124), has special significance. Whatever answer may ultimately be found to the riddle of its authorship[72], we know from GOETHE's own statement[73], made nearly half a century after the *'Fragment'*, as it was originally called, appeared, that, in looking back over his scientific career, he regarded *Die Natur* as representing the views which he had held in the earlier part of the decade preceding the publication of the *Metamorphose,* and which he considered that he had since outgrown. Throughout the poem runs the thread of an intense awareness of the antithetic and paradoxical attributes characterising those aspects of the universe which the writer personifies as *Die Natur.* GOETHE may well have been for a time overmastered by the consciousness of such contradictions, but his mental bias would not let him rest permanently at this stage; he soon began to seek, and to believe that he had found, a reconcilement of the antithetic elements in existence. His solution was not, however, truly synthetic, since it led him to stress the One, and to absorb the Many into it. It is possible to hold that his devotion to the idea of the One led to a certain sacrifice of his intellectual integrity. Hankering, as he did, to regard Nature as unified and directional, rather than inconstant and capricious, he came to see her apparent inconsistencies merely as masks for essential oneness. It was from this viewpoint that his morphological work was developed. According to the theory of plant members, which he put forward in the *Metamorphose,* he visualised the indescribably various appendicular organs of plants all as expressions of one form—the leaf. In his wider study of morphology he went further in the same direction, and he reached the concept of a single

68. Sophien-Ausgabe, Abth. II, Bd. 13 (Nachträge zu Bd. 6-12), Nachträge zu Bd. 7. Paralipomena 137, p. 132.
69. SCHUSTER, J. (1924): *l.c.,* Fig. 2, p. 79.
70. Sophien-Ausgabe, Bd. 32. *Italiänische Reise. III. Zweiter Römische Aufenthalt. Störende Naturbetrachtungen.* P. 47 (July 1787).
71. Sophien-Ausgabe, Bd. 32, *Lesarten* (June and July 1787), p. 389.
72. On this question *see* pp. 119-120.
73. Letter to Kanzler F. T. A. H. VON MUELLER, May 24, 1828, TROLL ed., p. 447.

type in accordance with which everything was fashioned (den Begriff des Typus, nach dem sich alles bildet)[74]. Though he made this idea peculiarly his own, he did not originate it. It is a device for figuring out the problems of existence to which those who see these problems on broad lines have frequently resorted[75]. In the *Metamorphose* the type concept is implicit rather than explicit; the word *Urblatt,* for the type leaf, does not occur[76]. In his other notes and writings the idea of the type is more fully developed, but the meaning which he attached to its defies exact definition; he thought of it as a Proteus that eludes any one form of expression and can only be glimpsed in a piecemeal and paradoxical fashion[77]. Moreover, in trying to convey his views in another tongue, we are faced with the difficulty that in English we have nothing really equivalent to those words with an *Ur* prefix which GOETHE employed in this connexion (*Urbild, Urtier, Urpflanze,* etc.). Fortunately the significance of the type concept is revealed in the examples which he cites, rather than in any verbal formulation. He suggests, for instance, that the *Orchidaceae* might be described as monstrous *Liliaceae*[78]; that is to say, he thought of them as a teratological deviation from the *Liliaceae* type. He would, indeed, have been pleased with a recent account of an abnormal flower of *Cypripedium,* which was trimerous and perfectly regular[79]. It would be an error to suppose, on the ground of his ideas upon the relation of flower structure in the *Orchidaceae* and *Liliaceae,* that GOETHE thought of the "type" as an ancestral form, which had had actual existence at some previous period, for he was not an evolutionist in the modern sense[80]. On his view the "Urpflanze" could neither be described adequately in words, nor represented pictorially—an essential limitation which some of his followers unfortunately ignored. His type concept has frequently been equated with the *forms* or *ideas* of PLATO[81], and some of GOETHE's expressions may be interpreted as indicating that he so regarded it, but it[82] is doubtful if this identification can be accepted. HANSEN[83] is probably right in his opinion that GOETHE's "Blatt" is, on the contrary, a conjectural concept, enabling a hypothetical situation to be visualised. On this reading it is recognised as comparable with such terms as atom and molecule, and as thus being merely a tool of thought. From this standpoint, which has much to favour it — though GOETHE himself would by no means have accepted it — the type concept is seen as having merely provisional status, so that we are justified in discarding it when it has served its turn in leading us to something more

74. Note appended to a letter to NEES VON ESENBECK, April 2, 1828. *Goethes Briefe.* Sophien-Ausgabe, Bd. 44, p. 54.

75. *See* especially an interesting study of J. B. ROBINET and the type concept in LOVEJOY, A. O. (1936): *The Great Chain of Being.* Harvard University Press; pp. 269-83.

76. On this point *see* HANSEN, A. (1919): *Goethes Morphologie.* Giessen; p. 26.

77. *Vorarbeiten zu einer Physiologie der Pflanzen. Einleitung.* Sophien-Ausgabe, Abth. II, Bd. 6, Theil I, p. 312-3.

78. *Nacharbeiten und Sammlungen.* TROLL ed., p. 251.

79. CURTIS, J. T. (1941): *Peloric Flowers in Cypripedium reginae Walt.* Amer. Midland Nat., vol. 25, pp. 580-3.

80. It seems scarcely possible to accept SHERRINGTON's suggestion that GOETHE's views were akin to those of LAMARCK; *l.c.,* p. 20.

81. *See,* for example, SHERRINGTON, C. (1942): *l.c.,* p. 22.

82. GOETHE speaks, for instance, of the type animal (Urtier) as "den Begriff, die Idee des Tieres"; see *Der Inhalt bevorwortet,* in *Zur Morphologie,* TROLL ed., p. 122.

83. HANSEN, A. (1907) *l.c.,* p. 91.

adequate. For instance, if we adopt the partial-shoot hypothesis of the leaf —as representing an advance upon GOETHE's thought—we need no longer postulate a type-phyllome from which all the lateral appendages of the stem have been derived; for on this view they are not derived *from one another,* but are related merely in so far as they are all incomplete shoots. They are therefore parallel but independent members, rather than divergences from a single primaeval leaf form. GOETHE in 1784 spoke of "paralleling" organic parts which are alike in their inner nature, but wholly unlike in appearance[84], but he did not develop this suggestion, nor did he realise that the notion of parallelism might eventually replace his naiver type concept[85].

In GOETHE's eyes the type principle was the clue to the interpretation of animals as well as plants. It was through this principle that in zoology he reached an important factual discovery—which was not, however, as completely new as he believed it to be[86] — that of the intermaxillary bone in man[87]. None of GOETHE's thinking was ever isolated from his whole mental activity, and the type concept, or, more widely, the idea of *Ur* phenomena, was to him a clue to be followed not in science merely; it was, rather, one of the keys which gave him the freedom of the universe as a whole. He applied this concept to man (*Urmensch*), and even to the landscape which forms his background (*Urlandschaft*). This development of the type concept lies outside our present scope; for a stimulating study of it, the reader may be referred to HUMPHRY TREVELYAN's work[88].

It was not until late in GOETHE's life that he came into contact with A. P. DE CANDOLLE's cognate ideas. In 1828, F. J. SORET, a Swiss friend, introduced him to DE CANDOLLE's *Organographie végétale,* which had been published in the previous year. GOETHE was greatly impressed by the doctrine of symmetry there developed, a doctrine which bore some affinity to his own views. He planned a work[89] to include a French version of the *Metamorphose,* and also the chapter in DE CANDOLLE's *Organographie,* "Sur la symétrie des plantes", and other representative extracts from this book, and from DE CANDOLLE's *Théorie élémentaire* (1813), accompanied by German translations. The work as eventually published was much reduced, and the projected DE CANDOLLE section was omitted, but the fact that GOETHE had intended to introduce it, shows that he felt no jealous rivalry; on the contrary, he expressed his wonder at the power shown by the Master—as he calls DE CANDOLLE—in handling an infinity of detail[90]. DE CANDOLLE's views had been reached independently, for it is recorded by his son[91] that his

84. *Versuch aus der vergleichenden Knochenlehre.* (1784). TROLL ed., p. 380.
85. On the replacement of the *type* concept by that of *parallelism, cf.* ARBER, A. (1937): *The Interpretation of the Flower: a study of some aspects of morphological thought.* Biol. Rev. (Cambridge, England), vol. 12, pp. 157-84; *see* pp. 173 etc.
86. SHERRINGTON, C. (1942): *l.c.,* pp. 21-2.
87. *Versuch aus der vergleichenden Knochenlehre, dass der Zwischenknochen der obern Kinnlade dem Menschen mit den übrigen Tieren gemein sei.* (1784). TROLL ed. p. 363 *et seq.*
88. TREVELYAN, H. (1941): *Goethe and the Greeks.* Cambridge, England. *See* Chap. IV, especially pp. 159-78.
89. UHDE, H. (1877): *Goethe Briefe an Soret.* Stuttgart. Letter to SORET dated August 3, 1828, pp. 56, 57. Also Sophien-Ausgabe, Abt. II, Bd. 13 (Nachträge zu Bd. 6-12), Nachträge zu Bd. 6, paralipomena 70, p. 63.
90. UHDE, H. (1877): *l.c.* Letters to SORET, July 14, 1828, p. 51, and June 28, 1828, p. 43.
91. CANDOLLE, A. P. DE (1862): *Mémoires et Souvenirs.* Genève et Paris; p. 573.

father did not read German, and that he knew nothing of the *Metamorphose* until 1823—more than thirty years after its publication—when a friend sent him an epitome of it in French; he was thus not fully acquainted with it even when he produced the *Organographie* in 1827. GOETHE showed no bitterness at this disregard of his work, which was, indeed, eventually more than compensated by the part which DE CANDOLLE's pupils played in disseminating the ideas developed in the *Metamorphose*[92]. One is tempted to think that there would have been more effective contact between GOETHE and DE CANDOLLE if they had been born two centuries earlier, when Latin was the *lingua franca* of scientific men.

DE CANDOLLE's morphology centred in the notion of the basic symmetry of all plant forms — "la symétrie normale ou primitive des êtres"[93]. The asymmetry that, in fact, frequently occurs, he regarded as secondary, and as requiring in each case some special explanation. We cannot here trace the history of the symmetry conception; it was not new when DE CANDOLLE propounded it, but he was the first to give it full expression. DE CANDOLLE's law of symmetry, and GOETHE's principle of metamorphosis, were in no way incompatible. They were concerned with the same phenomena, though seen from somewhat different standpoints; each contained something of the truth, though neither was the whole truth. Like GOETHE, DE CANDOLLE was not far from taking the step which would have set him on the way to the conception of the leaf as a partial shoot; his doctrine would indeed have fitted exactly with the notion of the leaf as a shoot which — owing to its relation to the parent shoot — has lost its radial symmetry and retained dorsiventral symmetry alone. But for his close adherence to root, stem, and leaf, as rigidly discrete units (organes fondamentaux)[94], which cannot be interpreted in terms of one another, he might have seen how to relate the leaf to the shoot, instead of leaving this feat to be accomplished by his grandson, CASIMIR, many years later.

So far as we know, DE CANDOLLE never concerned himself about the differences between his own mentality and that of GOETHE. GOETHE, however, with his intense interest in psychological problems, discusses these differences, and their results, in a way which throws light upon his own general attitude to scientific work. In a letter to SORET of April 2, 1828[95], GOETHE treats DE CANDOLLE's work and his own as exemplifying the contrast between analysis and synthesis. He held these two modes of approach to be reciprocal, mutually helpful even in their antagonisms, and equally indispensable both in theory and in practice. Though he knew that analysis was essential, and respected and admired it in DE CANDOLLE, it was synthesis to which the whole of his mental and psychical equipment inclined him personally. How deep-seated his feeling for synthesis was, is indicated by his prophecy that poetry and science, which in his day dwelt in total isolation, would eventually come to a happy meeting on a higher plane.[96]

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92. *See* p. 86.
93. CANDOLLE, A. P. DE (1827): *Organographie végétale*, Paris, vol. 2, p. 240.
94. CANDOLLE, A. P. DE (1827): *l.c.*, vol. 1, pp. 139-40.
95. *See* SCHUSTER, J. (1924): *l.c.*, pp. 107-8.
96. *Schicksal der Druckschrift.* TROLL ed., p. 215.

In the fragmentary *Zur Morphologie,* published in 1817, GOETHE emphasizes the disadvantages to biology of the analytical approach through chemistry and anatomy. He says that, by this method, the living creature is dissected into its elements, but that from these elements it is impossible to reconstitute and reanimate it[97]. Those today who advocate a holistic or organismal view of life, have often used expressions almost identical with this of GOETHE's, but without realising that he had been there before them.

GOETHE's synthetic views share the difficulty which besets holistic interpretations in general — that they tend to carry the enquirer out of the sphere of science, which, in the stricter sense, is a discipline obtaining its results by the application of methods of a manageable kind. SCHILLER, in a letter to GOETHE written in 1794[98], points out that to embark on the heroic path of taking all Nature together, and seeking in the totality of phenomena for the explanation of the individual, is to reach after a goal which there is no hope of attaining in a lifetime. GOETHE's own solution of this difficulty did not lie in the attempt to apply scientific method where he felt it to be out of place, but in the development of symbolic thought. Faced with the manifoldness of phenomena, he tried to reconcile it with his basic idea of the unity of all things, by striving to discern the Whole in the tiniest individual thing[99]. Any subject, however small and limited, with which he concerned himself, became for him the microcosm of something universal; it is not surprising that he was conscious of a special appeal in the Old Testament story of SAUL, the son of KISH, who went forth to seek his father's asses, and found a kingdom[100].

Symbolic interpretations of experience came to be more and more important to GOETHE, especially in the latter part of his life[101]. Such interpretations involve a special stress upon *comparison,* and GOETHE's great service to morphology lay in the recognition that its basis must be essentially comparative. This comparative way of viewing nature contrasts with the method that is 'scientific' in the rigid sense, and consists in the attempt to treat biological phenomena on mechanical lines. The latter method had little attraction for GOETHE; he wrote that "The application of mechanical principles to organic Nature has only made us the more aware of the wholeness of the living being"[102]. In order to appreciate GOETHE's attitude, it is necessary to consider how his ideas were related to 'explanation', as this is generally understood in science. The word 'explanation' may be held to correspond to the German word 'Erklärung', TROLL's definition[103] of which includes setting forth the cause of a phenomenon, or finding the orderly place for a special fact in a causal sequence. This idea of explanation — as equivalent to the locating of the thing-to-be-explained in a chain of causation — was alien to GOETHE's mind; he held the view that "The thinker

97. *Die Absicht eingeleitet,* in *Zur Morphologie.* TROLL ed., pp. 114-5.
98. *Briefwechsel zwischen Schiller und Goethe.* Theil I, 1794 und 1795. Stuttgart und Tübingen, 1828, pp. 13-4.
99. "das Ganze im kleinsten erblicken". Quoted in TROLL, W. (1926): *l.c.*, p. 36.
100. *Wilhelm Meister's Lehrjahre.* Sophien-Ausgabe, Bd. 23, pp. 309-10.
101. TROLL, W. (1926): *l.c.*, p. 97 *et seq.*
102. *Betrachtung über Morphologie überhaupt.* TROLL ed., p. 229.
103. TROLL, W. (1925): *Gestalt und Gesetz.* Flora, N. F. Bd. 18 and 19 (G. R. Bd. 118 and 119), GOEBEL Festschrift, pp. 536-65; *see* p. 556.

makes a great mistake when he asks after cause and effect; they both together make up the indivisible phenomenon"[104]. He recognised, however, that to range appearances under the various forms of causation was an activity arising inevitably from the construction of the human mind, and he was prepared to regard this as justifiable, even when it fell outside his own scheme of things. For instance, in discussing VAUCHER's work, GOETHE speaks of this author's explanations of physiological phenomena in terms of purpose, as being foreign to his own outlook, but adds that he quarrels with no one who chooses to adopt the standpoint of teleology[105].

For the type of explanation based on cause and effect, GOETHE substituted a process that can be described only by the untranslatable German word, 'Darstellung', which may be defined, approximately, as the demonstration or representation of an object, brought into relation with others in such a way that its significance is revealed[106]. GOETHE himself spoke of morphology as a discipline which "nur darstellen und nicht erklären will"[107].

We know that GOETHE's actual visual impressions were peculiarly intense, and greatly influenced his mode of thought; indeed, his inclination always drew him to 'picture thinking'. For this way of apprehending nature, TROLL[108] uses the expression "intuitive Anschauung", which might be called, "thinking with the mind's eye"; it lies midway between sensuous perceptions reached through bodily sight, and the abstract conceptions of the intellect. Actually to "see", as it were, the solution of a problem, is, to most biologists, an experience as rare as it is delightful; but GOETHE's mind worked in this way all the time. He even made a vigorous and prolonged attempt to apply the 'Anschauung' method to physics, an attempt which was obviously foredoomed to failure. He tried to tackle the problems offered by colour[109], on the assumption that such physical questions could be studied non-mathematically. Even here, however, it is possible to hold that his attitude — fantastic as it may appear when judged from the standpoint of modern physics — was not entirely devoid of value. There is a modicum of truth underlying the picturesque exaggeration of CROCE's statement that GOETHE, "emerging from a century intoxicated with mathematics, understood and had the courage to assert that mathematics do not lead to the knowledge of reality, and that in them there is nothing exact but their own exactness"[110].

GOETHE was not at home in thought which was purely abstract; he says of himself that for philosophy in the strict sense he had no capacity (kein

104. SAUNDERS, [T.] BAILEY (1893): *l.c.*, No. 394, p. 146.

105. *Wirkung meiner Schrift.* TROLL ed., p. 259; for GOETHE's views on teleology, *see* ECKERMANN, J. P. (1836): *Gespräche mit Goethe in den letzten Jahren seines Lebens. 1823-1832.* Theil II. Leipzig; p. 282; and *Conversations of Goethe with Eckermann and Soret* (1850): Translated by J. OXENFORD. London; vol. 2, p. 347.

106. TROLL, W. (1925): *l.c.*

107. *Betrachtung über Morphologie überhaupt.* TROLL ed., p. 228.

108. On this subject *see* TROLL, W. (1926): *l.c.*, p. 78, etc., and HANSEN, A. (1907): *l.c.*, pp. 277-8.

109. For an interesting and clear account of GOETHE's *Farbenlehre, see* SHERRINGTON, C. (1942): *l.c.*, pp. 8-18.

110. CROCE, B. (1923): *Goethe.* Translated by E. ANDERSON, with an introduction by D. AINSLIE. London; p. 14.

Organ)[111]. SCHILLER[112], with his keener power of thought on the philosophic plane, criticised GOETHE as apprehending all too much through the senses. Despite such drawbacks, GOETHE's mode of approach had, and still has, a special and original quality; for in including and emphasizing visual perception, and relating it to thought on the non-tangible plane, it points the way towards a reconcilement of the purely abstract with the purely sensuous. Early in this Introduction, we spoke of the vexed question of GOETHE's scientific status. After a consideration of his biological thought, this question still remains fraught with difficulty, for the catholicity of his mind, and the kaleidoscopic character of his activity, defy neat labelling. As a botanist, he began with a simple utilitarian interest in plants; he passed through a brief period in which he studied the multiplicity of the plant world from the standpoint of the descriptive naturalist; this was succeeded by a phase in which his mind was entirely possessed by comparative morphology, a subject to which the value of his contribution, and the inspiration which later workers have derived from it, are undeniable; and, finally, by a transition natural to his mental growth, he reached a stage in which his morphological thought reached out to the reconciliation of the antithesis between the senses and the intellect, an antithesis with which traditional science does not attempt to cope. It has been suggested by a literary critic that GOETHE was "a great poet who *grew out* of poetry"[113]. Approaching him, as we have done here, through the medium of his plant studies, we may perhaps offer the comparable conclusion, that GOETHE was a great biologist, who, in the long run, overstepped the bounds of science.

A Note on Translations: — Two French translations of the *Versuch die Metamorphose der Pflanzen zu erklären* (1790) were published in GOETHE's lifetime, both by Swiss botanists who had been pupils of DE CANDOLLE. The earlier, by F. GINGINS-LASSARAZ, appeared in 1829[114]; in GOETHE's own copy of this work there are manuscript notes pointing to its infidelity and incompleteness[115]. The second translation, by F. J. SORET, came out two years later: *Essai sur la Métamorphose des Plantes . . . suivi de notes historiques,* Stuttgart, 1831[116]. SORET, who criticised GINGINS-LASSARAZ as having used nineteenth-century technical terms, which were an anachronism[116a], described his own version as "travaillée avec soin sous les yeux mêmes de l'auteur". GOETHE was enthusiastic about this translation, which he spoke of, while it was in progress, as being "more and more felicitous"[117]; but it is too free to be as helpful as might have been expected in the interpretation of obscure points. It seems probable that GOETHE, in his old age, did not, in reality, criticise it intensively, and also that he gave SORET con-

111. *Einwirkung der neueren Philosophie.* TROLL ed., p. 285.
112. *Schillers Briefwechsel mit Koerner* (1847): Teil II. Berlin. Letter of Nov. 1, 1790, p. 207.
113. *The Centenary of Goethe.* Times Literary Supplement. London. March 24, 1932, p. 210.
114. *Essai sur la Métamorphose des Plantes, Traduit de l'Allemand sur l'Édition originale de Gotha* (1790) par M. FRÉDÉRIC DE GINGINS-LASSARAZ. Genève, 1829.
115. SCHUSTER, J. (1924): *l.c.*, p. 110, footnote 3.
116. For the German title *see* citation in footnote 1, p. 67.
116a. UHDE, H. (1877): *l.c.*, p. 93.
117. *Conversations of Goethe with Eckermann and Soret* (1850): *l.c.*, vol. 2, p. 374; ECKERMANN, J. P. (1836): *l.c.*, p. 317.

siderable latitude, because he held that the differences between French and German mentality made it necessary for his ideas to be presented in a somewhat different guise when they were intended for a French audience. He feared that a nation, which demands in everything entire clarity of expression and thought, might suspect him of falling into mystic reveries if he wrote for them in the style which it was natural for him to use in addressing his compatriots[118].

Five years after GOETHE's death, another French translation appeared from C. F. MARTINS[119].

It was not until 1863 that a version was published in English: *Essay on the Metamorphosis of Plants,* Translated by EMILY M. COX; with Explanatory Notes by MAXWELL T. MASTERS (*Journal of Botany,* vol. 1, pp. 327-45, 360-74, 1 pl.). My own translation, which follows this Note, was made independently, but, when it was completed, I compared it throughout with the *Journal of Botany* version, and, wherever the latter seemed to me to convey the sense more accurately than my own, I modified mine in accordance with it.

Another English translation appeared in the *Notes and Correspondence of the Anthrosophical Agricultural Foundation,* vol. 4, No. 8, April 1937. I am indebted to Mr. W. T. STEARN for showing me this version in the year of its publication, but I have not been able to consult it during the preparation of my own rendering. It is described as based on the *Journal of Botany* translation, and on another by Mrs. MIRBT; it has an introduction by G. KAUFMANN.

Those who are curious in such matters may find amusement in certain specimens of poetical versions which appeared in the *Gardener's Chronicle,* vol. 4, 1844, pp. 117 and 133.

In translating the title of GOETHE's book, I have used the word "Attempt", instead of "Essay", for "Versuch", because I believe that "Attempt" more nearly expresses GOETHE's intention. BATSCH's introduction to botany, which was published three years before GOETHE's work, and which he cites, may have suggested the form of the title, for it is called *Versuch einer Anleitung zur Kenntniss und Geschichte der Pflanzen.* BATSCH's work is a solid and detailed textbook; it cannot be called an "Essay", if the word is used in the sense which has in general been attached to it from the days of MONTAIGNE onwards. It seems safe to assume that GOETHE, in his first edition, followed BATSCH in employing the term "Versuch" in the modest sense of "something attempted" — a sense which the English word "essay" conveyed in former days, but which it has now lost. In SORET's French and German issue of 1831, the title losing something of its humility, is changed to *Versuch über die Metamorphose der Pflanzen;* here the word "Essay" seems to be the best equivalent for "Versuch", and "Essai" is used in the French translation.

In the following version, those footnotes, or parts of footnotes, which are not in the original text, are initialled (A.A.). Readers who wish for fuller annotation will find it in TROLL ed., p. 455 *et seq.*

118. *See* SORET's translation, p. 225.
119. Title cited on p. 74.

J. W. von Goethe

Herzoglich Sachſen-Weimariſchen Geheimenraths

Verſuch

die Metamorphoſe

der Pflanzen

zu erklären.

Gotha,

bey Carl Wilhelm Ettinger.

1790.

TRANSLATION

An ATTEMPT *to* INTERPRET *the* METAMORPHOSIS *of* PLANTS

by

J. W. von GOETHE

1790

[*For facsimile of title page of original edition, see opposite page*]

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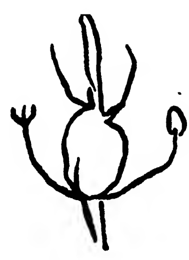

I am indeed not unaware that this path is obscured by clouds, which will pass over from time to time. Yet these clouds will easily be dispersed when it is possible to make the fullest use of the light of experience. For Nature always resembles herself, although she often seems to us, on account of the inevitable deficiency of our observations, to disagree with herself. (LINNAEUS, Anticipation in Plants, Diss. I[120]).

INTRODUCTION

§ 1

Anyone who pays a little attention to the growth of plants will readily observe that certain of their external members are sometimes transformed, so that they assume — either wholly or in some lesser degree — the form of the members nearest in the series.

§ 2

Thus, for example, the usual process by which a single flower becomes double, is that, instead of filaments and anthers, petals are developed; these either show a complete resemblance in form and colour to the other leaves of the corolla, or they still carry some visible traces of their origin.

§ 3

If we note that it is in this way possible for the plant to take a step backwards and thus to reverse the order of growth, we shall obtain so much the more insight into Nature's regular procedure; and we shall make the acquaintance of the laws of transmutation, according to which she produces one part from another, and sets before us the most varied forms through modification of a single organ.

§ 4

The underlying kinship of the various external members of the plant. such as the leaves, calyx, corolla, and stamens, which develop after one another, and, as it were, from one another, has long been recognised by naturalists in a general way; it has indeed received special attention, and the process, by which one and the same organ presents itself to our eyes under protean forms, has been called the *Metamorphosis of Plants.*

§ 5

This metamorphosis displays itself in three modes: *normal, abnormal,* and *fortuitous.*

§ 6

Normal metamorphosis may also be called *progressive*: for it is that which may be perceived always working step by step from the first seed-leaves to the final development of the fruit. Through the change of one form into another, it passes by an ascent — ladder-like in the mind's eye —

120. This is the translation of the citation as given by GOETHE; the full reference is ULLMARK, H. (1764): *Prolepsis plantarum. In* LINNAEUS, C., *Amoenitates Academicae,* Lugduni Batavorum. Vol. 6, No. cxviii, p. 341. (A.A.).

to that goal of Nature, sexual reproduction. It is this progression which I have studied attentively for a number of years, and which I shall attempt to elucidate in the present essay. This being our standpoint, we will consider the plant, in the following demonstration, only in so far as it is an annual, and passes by continuous progression from the seed up to the fructification.

§ 7

We may give the name of *retrograde* metamorphosis to that which is *abnormal.* As in the normal course, Nature hastens forward to her great end, so in the abnormal, she takes one or more steps backwards. As she there, with irresistible impulse and the full exertion of her might, fashions the flowers and prepares them for the works of love; so here she slackens, as it were, and leaves her creation before it reaches its goal, in an undetermined and powerless condition. Though in this state it is often agreeable to our eyes, in its true inwardness it is feeble and ineffectual. From our acquaintance with this abnormal metamorphosis, we are enabled to unveil the secrets that normal metamorphosis conceals from us, and to see distinctly what, from the regular course of development, we can only infer. And it is by this procedure that we hope to achieve most surely the end which we have in view.

§ 8

We will, on the other hand, avert our eyes from the third kind of metamorphosis, which comes about *contingently,* as a result of external causes, especially through the action of insects; for this phenomenon might frustrate our purpose by diverting us from the direct path which we ought to follow. Perhaps there will be an opportunity to speak elsewhere of these excrescences, which, though monstrous, are still subject to definite limitations.

§ 9

I have ventured to draw up the present work without giving illustrative plates, which however in many respects might seem necessary. I propose to reserve them for the sequel, which can be done the more easily, since enough material is left over for the elucidation and further development of the present short and merely preliminary essay. It will not then be necessary to produce so formal a treatise as this one. I shall have the opportunity of bringing forward much cognate matter; and passages extracted from authors of a like way of thinking will then find their natural place. Especially I will not fail to make use of any suggestions from the experts who today are the glory of this noble science. It is to them that I commit and dedicate these pages.

I. CONCERNING THE SEED-LEAVES

§ 10

Since we have undertaken to observe the sequence of stages of plant growth, let us turn our attention forthwith to the plant at the moment when it germinates. At this stage we may easily and exactly recognise the parts which directly belong to it. It leaves its husks more or less completely in the earth; these we will not now investigate. In many cases, when the root

has anchored itself in the soil, the plant brings forth into the light the first organs of its upper growth, which were already present, hidden within the seed-coat.

§ 11

These first organs are known under the name of *Cotyledons.* They have also been called seed-valves, kernel-pieces, seed-lobes, and seed-leaves; these names are an attempt to denote the various forms which the cotyledons assume.

§ 12

They often appear shapeless, crammed, as it were, with crude matter, and as much extended in thickness as in breadth[121]; their vessels are unrecognisable, and scarcely to be distinguished from the mass as a whole. These cotyledons bear scarcely any resemblance to a leaf, and we may be misled into taking them for organs belonging to some special category.

§ 13

Nevertheless in many plants they approach leaf form; they increase in area and become thinner; when exposed to light and air they assume a deeper green; the vessels which they contain become more recognisable, and more similar to the veins of a leaf.

§ 14

Finally they appear before us as true leaves, the vessels of which are capable of the finest development. Their resemblance to the succeeding leaves prevents our taking them for special organs; we recognise them, rather, as the first leaves of the stem.

§ 15

But since we cannot think of a leaf without a node, or of a node without a bud, we may be allowed to conclude that the point where the cotyledons are attached is the veritable first nodal point of the plant. Confirmation of this view is afforded by those plants which put forth young buds immediately at the base of the cotyledonary wings, and produce complete shoots from the first nodes, as the horse-bean (*Vicia Faba* L.) is wont to do.

§ 16

The cotyledons are generally twinned, and this leads us to make an observation, the significance of which will be more fully appreciated at a later point. This is that the leaves of this first node are often *paired* when the succeeding leaves of the stem stand *alternately;* there is here an approach and association of parts which Nature, later in the sequence, disjoins and separates from one another. This is still more noticeable when the cotyledons take the form of numerous small leaves assembled round a common axis, while the stem, developing gradually from their midst, bears the succeeding leaves singly, round about itself. This can be observed to perfection in the growth of conifers. Here the wreath of needles forms, as it were, a calyx. We shall have to recall these cases in connexion with similar phenomena which we shall meet later.

121. Soret ed., p. 9, translates this incorrectly as "aussi épais que longs". (A.A.)

§ 17

We will not now occupy ourselves with the single cotyledons of indefinite form belonging to those plants which germinate with one leaf.

§ 18

We will, however, notice that even the most leaf-like cotyledons themselves are always relatively undeveloped as compared with the later leaves of the shoot. Their outline, especially, is extremely simple, and bears as little trace of indentations as their surfaces do of hairs or other vessels (Gefässe)[122] characteristic of the mature leaf.

II. DEVELOPMENT OF THE STEM-LEAVES FROM NODE TO NODE

§ 19

We are able now to study accurately the successive formation of the leaves, since the progressive operations of Nature all take place, step by step, under our eyes. A variable number of the succeeding leaves are often already present within the seed, and lie enclosed between the cotyledons; while still in their folded condition they are known under the name of the plumule. The relation of their form to that of the cotyledons and of the following leaves differs in different plants, but they generally diverge from the cotyledons in being expanded and thin in texture; on the whole fashioned as typical leaves; fully green in colour; and attached to an obvious node. Their relationship to the later stem-leaves is indubitable, but they are commonly inferior to them in the fact that their periphery or margin has not reached its full elaboration.

§ 20

The leaf shows a continuous development from node to node, as the midrib elongates, and the lateral veins arising from it stretch out more or less on either hand. The various characters of the nervation are the principal cause of the multifarious forms met with in leaves. Leaves may be indented, deeply incised, or formed of many leaflets; in the last case they prefigure complete small shoots. The date palm affords a striking example of such graded diversification of the simplest leaf form. In a sequence of several leaves, the midrib is carried progressively further into the lamina; the fan-like simple leaf becomes torn and divided; and the end result is a highly complex leaf, vying with a branch.

§ 21

As the leaf itself arrives at the perfection of its form, so the leaf-stalk also develops correspondingly; it may either make a continuous whole with its leaf, or it may form a distinct stalklet, easily detachable at a later stage.

122. GOETHE uses *Gefässe* as a vague general term for anatomical elements forming the leaf (*cf.* also § 25). *See* SACHS, J. VON (1890): *History of Botany.* Trans. by GARNSEY, H. E. F. and BALFOUR, I. B., Oxford, p. 254, for the indefinite use of the word vessel in the eighteenth century. (A.A.)

ABNORMAL, FUNNEL-SHAPED, SPIRALLY CONTORTED SHOOT OF VALERIANA OFFICINALIS L., FROM TAF. 5 (CF. P. 72) OF SCHUSTER, J. (1924): L.C., AFTER STARK'S DRAWING FROM A SKETCH BY GOETHE. (SEE P. 79 OF TEXT.)

DIAGRAMMATIC LANDSCAPE TO ILLUSTRATE COMPARATIVE ALTITUDES IN THE OLD AND NEW WORLDS, DRAWN BY GOETHE TO ILLUSTRATE VON HUMBOLDT'S *Ideen zu einer Geographie der Pflanzen, nebst einem Naturgemälde der Tropenländer* REPRODUCED FROM ALLG. GEOGR. EPHEMERIDEN, VOL. XLI, PP. 5-8 (1813)

Goethea cauliflora H. et M., type species of the genus Goethea, after Wild's drawing in Nova Acta, vol. 2, pl. viii.

§ 22

We see in various plants, for example the orange tribe[123], that this independent leaf-stalk may also have a tendency to transform itself into a leaf-like form. The organisation of such leaf-stalks will in the sequel suggest some considerations to us, which we will put aside for the present.

§ 23

Neither can we now enter upon a special investigation of stipules; we only remark in passing that, especially when they form part of the leaf-stalk, they also become remarkably transformed in the course of its further change.

§ 24

Now as the leaves owe their first nourishment principally to the more or less modified watery fluid which they draw from the stem, so they are indebted to the air and the light for their main development and elaboration. As we find the cotyledons, produced within the closed seed coat, charged as it were with a crude sap only, and organised and developed scarcely at all, or merely in a rough fashion; so the leaves of plants which grow under water are of less perfect organisation than those exposed to the open air. Again, the same plant species develops smoother and less highly perfected leaves when it grows in low and damp places; if on the contrary it is transferred to a higher situation, it produces leaves which are rough, hairy, and more elaborately formed.

§ 25

The vessels[124] which form the skin of the leaf, and which arise from the ribs and feel their way towards one another by their tips, are similarly influenced; their anastomosis, if not altogether caused, is at least much promoted by the more subtle kinds of gas. We are inclined to ascribe to lack of complete anastomosis the fact that the leaves of many plants which grow under water are thread-like or antler-like. The mode of growth of the water buttercup (*Ranunculus aquatilis* L.)[125] affords us clear evidence on this point, since its leaves produced under water have thread-like ribs, while those developed above the water surface are formed with fully anastomosed and entire blades. Indeed the transition can be accurately traced in leaves of this plant which are partly anastomosed and partly thread-like.

§ 26

It has been learnt experimentally that the leaves of plants absorb different gases and combine them with their internal moisture; nor does any doubt remain that they return these refined saps to the stem, and thus greatly promote the growth of the neighbouring buds. The kinds of gas developed from the leaves of many plants, and also from the cavities of reeds[126], have been investigated with convincing results.

123. In a letter to SORET, July 14, 1828 (UHDE, H. (1877): *l.c.*, p. 51) GOETHE says that he used *Agrumen* (the word employed in § 22.) for "die ganze Sippschaft der Citronen, Pommeranzen u.s.w." (A.A.)

124. *See* note to §18. (A.A.)

125. GOETHE uses the name *Ranunculus aquaticus*. (A.A.)

126. The expression "Hölungen der Rohre" used here is translated "cavités des joncs" by SORET; "vaisseaux" by GINGINS-LASSARAZ and MARTINS; and "hollow stems" by COX. (A.A.)

§ 27

We observe in various plants that one node springs from another. In stems which are closed at the nodes[127], as in cereals, grasses, and reeds, this is obvious to the eye; but it is less conspicuous in other plants which have a hollow centre throughout, and appear to be filled with a pith or rather a cellular tissue. The rank, among the other anatomical regions of the plant, formerly held by the so-called pith is now however disputed[128], and, as it seems to us, on excellent grounds. Its apparently predominant influence in growth is denied, while all impetus and developmental force is, on the other hand, ascribed unhesitatingly to the inner face of the second cortex — the so-called *liber*. It thus becomes more convincing that an upper node — since it arises from the one below, and receives the sap by its mediation in a finer and more filtered state, improved by the action of the preceding leaves — must develop more perfectly and convey more delicate juices to its own leaves and buds.

§ 28

Since now the cruder saps are continually drained in this manner, and give rise to purer — the plant meanwhile perfecting itself step by step — the period prescribed by Nature is finally reached. At last we see the leaves in their greatest expansion and development, and soon afterwards we become aware of a new aspect which warns us that the epoch which hitherto we have been studying is past, and a second is approaching — the epoch of the *Flower.*

III. TRANSITION TO THE FLOWERING PHASE[129]

§ 29

We see the transition to anthesis come to pass either *relatively rapidly* or *relatively gradually*. In the latter case we commonly notice that the stem-leaves begin to draw in, as it were, from the periphery, and especially to lose their diverse marginal divisions, while, on the other hand, they show some expansion in their basal regions, where they are connected with the stem. At the same time we see that, even if the stem interval from node to node does not elongate markedly, nevertheless it is much more delicately and slenderly formed than in its earlier state.

§ 30

It has been observed that copious nourishment hinders the production of the inflorescence of a plant, while a moderate or indeed scanty supply of food hastens it. The action of the stem-leaves, considered above, shows itself here still more clearly. So long as cruder saps are still to be carried away, so long must there be production of those organs which are capable of fulfilling this need. If excessive nourishment is forced upon the plant, this operation must be continually repeated, and flowering is thus rendered well-nigh impossible. If, on the other hand, the plant is deprived of food,

127. Goethe's expression is "von Knoten zu Knoten geschlossen," but the examples he gives suggest that he actually meant "closed at the nodes". (A.A.)

128. Hedwig, Leipziger Magazin, Part III. (For full reference see p. 71 (A.A.))

129. The word which I have translated "flowering phase" is "Blüthenstand"; Goethe uses this term indifferently for inflorescence and for flower. (A.A.)

this natural process is facilitated and shortened; the foliar organs are refined, the operation of the unadulterated saps becomes purer and stronger, and the transformation of the parts is rendered possible and makes unimpeded progress.

IV. FORMATION OF THE CALYX

§ 31

We often see the change to the flowering phase occur *rapidly,* and in this case the stem, above the node of the uppermost leaf, suddenly becomes tall and slender, while several leaves are gathered together at its apex, grouped around a centre.

§ 32

It may, it seems to us, be proved most clearly that the leaves of the calyx are the same organs as those which up to the present have developed as stem-leaves, but are now, often in very different guise, collected round a common centre.

§ 33

We have already among cotyledons noticed a similar operation of Nature, and have seen several leaves, and thus clearly several nodes, collected round a point and approximated. The conifers, when they develop from the seed, show a radiating wreath of unmistakable needles, which, unlike the generality of other cotyledons, are already highly developed. We thus see, in the first infancy of this plant, an indication, as it were, of that power of Nature through which, at a greater age, inflorescence and infructescence will be produced.

§ 34

Further we see in various flowers unaltered stem-leaves collected into a kind of calyx immediately beneath the corolla. Since their form is completely characteristic, we need only, in proof of their being leaves, appeal to ocular evidence and to botanical terminology, which has distinguished them by the name of floral leaves, *Folia floria.*

§ 35

We have to observe with greater attention the case already mentioned, in which the transition to the inflorescence occurs *gradually.* Here the stem-leaves approach one another little by little, become transformed, and by degrees, as it were, pass into the calyx, as may easily be observed in the calyx[130] of the composites, especially the sunflowers and the marigolds.

§ 36

This faculty of Nature, which assembles a number of leaves round a centre, may be observed to bring about an even more intimate union, thus making these collected and modified leaves still less recognisable; for it unites them between themselves — sometimes completely, but often only partially — inducing concrescence of their lateral margins. The leaves — so closely crowded and pressed against one another — are most intimately

130. This, which Goethe calls "Kelch," is now described as an involucre of bracts. (A.A.)

in contact in their embryonic condition; they anastomose through the influence of the extremely pure sap present by this time in the plant, and appear before us as the bell-shaped or so-called one-leaved (monosepalous) calyx, which reveals its compound origin by the fact that its upper margin is more or less toothed or incised. We can find ocular evidence of this if we compare a number of deeply cut calyces with those that are many-leaved, especially when the calyces of various composites are exactly considered. We shall see, for example, that the calyx of the marigold, which in systematic descriptions is called *simple* and *much divided,* consists, in reality of many concrescent and superposed leaves, into which, as we have already mentioned, the contracted stem-leaves pass, as it were, almost insensibly.

§ 37

In many plants there is constancy in the number and form in which the sepals, whether free or fused, and the succeeding members are arranged round the stalk as an axis. On this constancy depends, in great part, the progress, the trustworthiness, and the repute of botanical science, which we of late have seen increasing more and more. In other plants the number and structure of these members is not equally constant, but even this inconstancy has been unable to baffle the delicate powers of discrimination of the master workers in this science; their endeavour has been by exact diagnosis to limit these anomalies of Nature, as it were, to a narrower sphere.

§ 38

In this way, then Nature formed the calyx: she *connected together* round a centre several leaves and consequently several nodes, generally according to a certain definite number and plan; these leaves and nodes she would otherwise have produced *successively and at some distance from one another.* If the flowering had been inhibited by the intrusion of superfluous nourishment, these leaves would have been spaced out, and would have appeared in their earlier form. Thus in the calyx Nature produces no new organ, but she unites and modifies only the organs already known to us, and in this way achieves a step towards the goal.

V. FORMATION OF THE COROLLA

§ 39

We have seen that the calyx owes its origin to elaborated saps, which are engendered by degrees in the plant, and that it is thus in its turn adapted for the production of a future organ of a further refinement. This idea can be confirmed when we interpret the process on purely mechanical grounds. For how extremely delicate, and suited to the finest filtration, those vessels must become, when they, as we have seen above, are in the closest contact and appressed to one another.

§ 40

We may observe the transition from calyx to corolla in more than one case; for although the colour of the calyx is still usually green, and remains similar to the colour of the stem-leaves, yet it often changes in one or other

of its regions — at the apices, margins, or back, or over its inner surface — while the outer still remains green; and we always see an increase of delicacy associated with this coloration. In this way ambiguous calyces come into being, which may equally well be taken for corollas.

§ 41

We have now remarked that from the cotyledons onwards there is a great extension and elaboration of the leaf, affecting its periphery in particular. Thence to the calyx there is a contraction of the outline, while, with the development of the corolla, we notice that a phase of expansion again sets in. The petals are generally larger than the sepals, and it is to be observed that the organs which were in a state of contraction in the calyx, at the stage now reached expand themselves as petals through the influence of purer saps, filtered through the calyx and in a high degree refined. They assume the appearance of entirely different organs, and their exquisite texture, their colour, and their scent, would quite obscure their origin for us, if it were not that in various exceptional cases we can spy out Nature's ways.

§ 42

So, for example, within the calyx of a pink, a second calyx is frequently found, which in part is fully green, and belongs to the type of the monophyllous toothed calyx, while in part it is laciniated, and, at its apices and margins, transformed into genuine beginnings of petals — delicate, expanded and coloured. Through such a case we once more clearly recognise the relationship of the corolla to the calyx.

§ 43

The relationship of the corolla to the stem-leaves is demonstrated to us in more than one manner; for in various plants stem-leaves occur which are already more or less tinted, long before they approach the inflorescence, while others, in the neighbourhood of the inflorescence, are completely coloured.

§ 44

It also frequently happens that Nature proceeds direct to the corolla, as it were skipping the calyx. In this case we likewise have the chance of observing that stem-leaves may pass into petals. So, for example, an almost completely developed and coloured petal may often be found on the stem of a tulip. A still more remarkable case is that in which such a leaf is half green, with its green half, which belongs to the stem, remaining attached thereto, while its coloured half is carried up with the corolla, so that the leaf is torn into two parts.

§ 45

It is a very probable idea that the colour and scent of the petals are to be attributed to the presence in them of the male fertilising substance[131]. Probably this substance occurs in them in a state in which it is not yet sufficiently isolated, but mixed and diluted with other juices. The beautiful phenomena of colour lead us to the conception that the material wherewith

131. The *Journal of Botany* version (Cox) translates this as "pollen," which does not render Goethe's expression, "männlichen Samens" accurately. (A.A.)

the petals are filled, though indeed it has achieved a high degree of purity, yet still has not reached the highest grade, in which it appears to us white and colourless.

VI. FORMATION OF THE ANDROECIUM

§ 46

The theory suggested in the preceding paragraph seems still more probable when we consider the near relationship of petals and androecium. Were the relationship of all the other parts to one another so obvious, so generally observed, and so indubitably settled, the present treatise might be held to be superfluous.

§ 47

Nature in some cases shows us this transition in the normal course of development, *e.g.* in *Canna,* and various plants of this family. A true petal, little changed, contracts in its upper margin, and an anther, in connexion with which the rest of the petal takes the place of a filament, makes its appearance.

§ 48

In flowers which are often double, we can observe this transition in all its stages. In several kinds of rose, within the fully developed and coloured petals, there are others which are contracted, sometimes in the middle and sometimes at the side; this contraction is caused by a little callosity, which appears as a more or less complete anther, while, in a degree corresponding to the degree of contraction, the leaf approaches the simpler form of a stamen. In some double poppies, fully developed anthers are borne upon little-changed petals of the strongly double corolla, while in others, anther-like callosities induce more or less contraction of the petals.

§ 49

If all the stamens are changed into petals, the flowers become sterile; but if in a flower, while it becomes double, staminal development still occurs, fertilisation takes place.

§ 50

And so an androecium arises, when the organs which we have hitherto seen expanded as petals, reappear in a highly contracted and, at the same time, a highly refined condition. The opinion propounded above is thus once more confirmed, and we are made more and more aware of this alternating process of contraction and expansion, whereby Nature ultimately attains her end.

VII. NECTARIES

§ 51

Abrupt as is the transition in many plants from the corolla to the androecium, yet we notice that Nature does not always make the passage in a single stride. On the contrary, she produces intermediate organs, which in form and function sometimes approach one member and sometimes the other. Although the structure of these intermediate organs varies greatly,

yet they can generally be brought together under the one conception that they are gradual transitions between the petals[132] *and the stamens.*

§ 52

Most of the variously formed organs, which Linnaeus distinguished with the name of Nectaries, may be grouped under this definition; and here we find an additional reason for admiring the keen insight of that extraordinary man, who, without having a quite clear idea of the function of this part, yet trusted to a presentiment, and took the risk of calling by the same name organs which were very diverse in appearance.

§ 53

Various petals show their relationship with the stamens by the fact that, without markedly changing their form, they bear little grooves or glands, which secrete a honey-like sap. That this is a fertilising fluid, though still imperfect and incompletely determinate, may be conjectured from the considerations already advanced, and this conjecture will reach a still higher degree of probability, for reasons which we will bring forward later.

§ 54

The so-called nectaries may also appear as independent members, and then they sometimes approach petals in their structure, and sometimes stamens. For example, the thirteen rays of the nectaries of the grass of Parnassus (*Parnassia*), with their corresponding number of red globules, are closely similar to the stamens. Others show themselves as filaments without anthers, as in *Vallisneria* and *Fevillea*. We find them in *Pentapetes* regularly alternating with the stamens in one whorl, but foliar in form; in systematic descriptions they are called petal-shaped emasculated filaments (*filamenta castrata petaliformia*). Just such forms, oscillating between the categories[133], are seen in *Kiggellaria* and the passion flower.

§ 55

Those peculiar organs — *coronas* — likewise seem to us to deserve the name of nectaries, in the sense defined above. For if the formation of petals is brought about through an expansion, so the corona is formed, on the contrary, through a contraction — that is to say, in the same way as the stamens. Thus we see smaller, restricted coronas succeeding the completer, more extended corollas, as for example in narcissus, oleander (*Nerium*), and agrostemma (*Lychnis coronaria* Desr.).

§ 56

Yet other still more striking and remarkable transformations of petals are to be seen in different genera. We notice in various flowers that their petals, on the inner surface at the base, have a small hollow, which is filled with a honey-like sap. This pit, when it becomes deeper in other genera and species, produces a spur- or horn-like prolongation from the back of the petal, and the form of the rest of the petal is correspondingly more or

132. Though the word "Kelchblätter" is here used, and is translated "feuilles du calice" by Soret, it seems to be an obvious slip for "Kronenblätter". (A.A.)

133. This translation though rather free, seems to convey the sense of "schwankende Bildungen". (A.A.)

less modified. We may observe this particularly in various species and varieties of the columbine (*Aquilegia*).

§ 57

This organ is found in the highest degree of modification, for example, in monkshood (*Aconitum*), and love-in-a-mist (*Nigella*), in which, however, a little attention reveals its foliar character; in *Nigella,* especially, the nectaries readily grow out again into petals, and the flowers become double through their transformation. In *Aconitum,* on careful inspection, the similarity of the nectaries to the hooded petals which enclose them can be detected.

§ 58

Having propounded the idea that the nectaries are approximations of the petals to the stamens, we may now take the opportunity to make some remarks about irregular flowers. So, for example, the five outer leaves of *Melianthus*[134] may be considered as true petals, but the five inner may be described as a corona, consisting of six nectaries, of which the uppermost approaches most nearly to petal form, while the furthest divergence is shown by the lowermost, which is indeed already called a nectary. In just the same sense, the keel (*carina*) of the papilionaceous flower may be called a nectary, since it is the one amongst the petals which most nearly approaches stamen form, and departs very widely from the leaf shape of the so-called standard (*vexillum*). In this manner we can quite easily explain the brush-like bodies which are found attached to the extremity of the keel in some species of milkwort (*Polygala*), and we can come to a clear idea as to the category to which this keel should be assigned.

§ 59

It is surely unnecessary to make the emphatic reservation that the intention of these remarks is not to introduce confusion into a subject which has been already subdivided and pigeon-holed by the efforts of observers and systematists. The writer wishes only to make the variations of plant form more comprehensible through the considerations here advanced.

VIII. FURTHER NOTES ON THE ANDROECIUM

§ 60

Microscopic observations decide beyond all doubt that the reproductive organs of plants, like their other parts, are produced by means of the spiral vessels. We thence deduce an argument for the inner identity of the various members of the plant, which hitherto have appeared to us in such multifarious forms.

§ 61

Now since the spiral vessels lie in the centre of the sap-vessel-bundles, and are enclosed by them, we may picture the condition of strong contraction somewhat more exactly if we imagine the spiral vessels — which appear to us indeed as elastic springs — in their state of utmost energy; they are then dominant, whereas the expansion of the sap-vessels is subordinated.

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134. On this case *see* Troll ed., p. 457. (A.A.)

§ 62

The abbreviated vascular bundles can now extend no more; they can no longer seek out one another, and no longer form a network through anastomosis; the tubular vessels, which otherwise fill up the interstices of the network, can no longer develop. All factors which have caused the expansion of the stem-leaves, sepals, and petals, vanish completely at this point, and a weak and extremely simple filament arises.

§ 63

The delicate membranes of the anther, between which the excessively tender vessels come to an end, are scarcely able to develop. If we now admit that at this stage those very vessels, which would otherwise have elongated, broadened, and again sought one another out, are at present in an extremely contracted condition; if we now see the highly elaborated pollen proceed from them, which compensates through its activity for what the vessels which produce it have lost in expansion; if it is at last set free and seeks out the female organ, which, through a natural correlation, occurs in the neighbourhood of the stamens; if it firmly adheres to this organ and communicates its influence to it: there is nothing then to prevent our calling the union of the two sexes an immaterial anastomosis, and believing that, at least for a moment, we have brought nearer together the concepts of growth and of reproduction.

§ 64

The delicate substance which develops in the anthers appears to us as a powder; but these pollen-grains are only vessels in which an extremely fine sap is stored. Hence we agree with the opinion of those who hold that the sap is imbibed by the pistils to which the pollen-grains adhere, and that thus fertilisation is brought about. This is the more probable since some plants secrete no pollen, but only a mere fluid.

§ 65

We recall to ourselves at this point the honey-like sap of the nectaries, and its probable relationship with the elaborated fluid of the seminal globules. Perhaps the nectaries are organs the function of which is preparation; perhaps their honey-like moisture is absorbed by the stamens, made more specific, and worked up fully — an opinion which is the more likely since after fertilisation this sap is no longer observable.

§ 66

We may just notice in passing that in some cases filaments, and, in others, anthers are concrescent, and offer us the most wonderful examples of the anastomosis and union of plant members which in their origin were truly distinct — a feature to which we have already more than once alluded.

IX. FORMATION OF THE STYLE

§ 67

As up to the present I have endeavoured as far as possible to make clear the inner identity of the various successively developed plant members, despite the very great deviations in their external form; so it will readily be conjectured that my object at this point is to explain the structure of the female organ in the same way.

§ 68

We will first of all consider the style apart from the fruit, as we indeed often find it in nature; and we can do this the more readily since in this form it shows itself distinct from the fruit.

§ 69

We notice, then, that the style remains at that stage of growth which characterises the stamens. We were able in fact to observe that the stamens originated through contraction. The styles are often in the same case, and we find them, if not always of similar dimensions to the stamens, still only to a small extent longer or shorter. In many examples the style is almost like a filament without an anther, and the relationship of their external form is closer than that of the other members. As they are both produced from spiral vessels, we see the more clearly that the female member has as little claim as the male to be regarded as an organ belonging to a special category; and if through this consideration we get a real insight into its exact relationship with the male, so we find the idea that fertilisation is a form of anastomosis the more pertinent and enlightening.

§ 70

We very often find the style produced by the concrescence of several distinct styles, while the members of which it consists can scarcely be distinguished, for not even at the tip are they always separated. This process of concrescence, the operation of which we have often noticed, is here even more possible than elsewhere; indeed it cannot but happen, since the delicate rudiments, before their development is completed, are compressed one against another in the midst of the flower, and may form the most intimate connexions between themselves.

§ 71

Nature shows us more or less clearly in various normal cases, the close relationship of the style with the preceding parts of the flower. So, for example, the pistil[135] of iris with its stigma presents to our eyes the complete form of a petal. The umbrella-shaped stigma of *Sarracenia* does not reveal itself so strikingly as compounded of several leaves, but its green colour does not discredit the idea. And with the help of a lens we find that various stigmas, such as those of crocus and *Zannichellia,* take the form of complete monophyllous or polyphyllous calyces.

§ 72

In retrograde development, Nature often shows us the case of styles and stigmas being again changed into petals; *Ranunculus asiaticus,* for example, becomes double by transformation of the stigmas and pistils of the female organ into veritable petals, while the stamens directly under this corolla are often unchanged. Some other significant instances will be cited below.

§ 73

We may recapitulate here the remarks made above, that styles and filaments represent corresponding phases of growth, and thereby once more

135. Goethe uses the word "Pistill", but he is probably not including the ovarian region. (A.A.)

illustrate the principle of alternating expansion and contraction. From the seed to the fullest development of the stem-leaves, we first noticed an expansion. After this we saw the calyx arise through a contraction; the petals through an expansion; the sexual organs once more through a contraction; and we shall soon become aware of the extreme of expansion in the fruit, and the extreme of concentration in the seed. In these six steps Nature in unresting sequence completes the eternal work of the bisexual reproduction of plants.

X. CONCERNING THE FRUITS

§ 74

We shall now have to observe the fruits, and we shall soon convince ourselves that they have the same origin as the other organs, and are subject to the same laws. We are speaking particularly of those seed-vessels which Nature forms to enclose the so-called covered seeds—or, rather, from the inner surface of which she develops a larger or smaller number of seeds as the result of fertilisation. That these seed-vessels are likewise to be explained from the nature and organisation of the members hitherto considered, can also be shown in a few words.

§ 75

Retrograde metamorphosis, again, brings this law of Nature home to us. So, for example, in the pinks — flowers which are well known and loved for their very degeneracy — it may often be noticed that the seed-capsules change back into calyx-like leaves, and that the styles shorten correspondingly. Indeed pinks occur in which the seed-vessel has changed into a calyx, real and complete, while its apical teeth still bear the delicate remains of the styles and stigmas, and, from the interior of this second calyx, a more or less perfect corolla is produced in place of the seeds.

§ 76

Further, Nature has herself in very diverse ways revealed to us, in forms regularly and constantly recurrent, the fruitfulness which lies concealed in the leaf. So the modified, but still completely recognisable, leaf of the lime tree, produces from its midrib a little stalk bearing a complete flower and fruit. In the butcher's broom (*Ruscus*) the manner in which flowers and fruit are borne on the leaves is still more striking.

§ 77

The direct fertility of the stem-leaves in the ferns strikes one as still more intense, and as almost monstrous. These leaves through an inner impulsion, and perhaps without the definite interaction of two sexes, develop and shed countless seeds, or rather gemmae, capable of growth. Here a leaf vies in fruitfulness with a spreading plant, or with a large and branching tree.

§ 78

Bearing these observations in mind, we cannot fail to recognise the leaf nature of the seed-vessels — notwithstanding their various forms, their special modification, and their relations among themselves. So, for example, the legume would be a simple folded leaf concrescent by its margins, while

siliquas would consist of several leaves, superposed and fused. Compound seed-vessels would be explained as consisting of several leaves united round a middle point, their inner faces open towards one another, and their margins united. We may convince ourselves of this by observing the appearance presented when such aggregated capsules spring apart after ripening, since each member then reveals itself as an opened pod or siliqua. Moreover a similar process regularly occurs in different species of one and the same genus; for example, the fruit capsule of *Nigella orientalis* takes the form of partly concrescent legumes grouped round a centre, while in *N. damascena* (love-in-a-mist) they appear fully fused.

§ 79

Nature hides the leafy character from our sight most effectually when she forms sappy and soft, or woody and tough seed-cases; but she will not be able to escape our scrutiny when we know how to follow her carefully in all transitional phases. Here it may be enough to have indicated the general conception involved, and to have referred to some examples showing Nature's accordance with it. The extreme multifariousness of seed-vessels gives us material for further consideration in the future.

§ 80

The relationship of the seed-vessels to the preceding members shows itself also in the stigma, which in many cases is sessile and inseparably bound up with the seed-vessel. We have already indicated the affinity of the stigma with leaf form, and we may here refer to it once again; for in double poppies it may be noticed that the stigmas of the seed-capsule are transformed into delicate little coloured leaves, completely resembling petals.

§ 81

The last and most important expansion which the plant exhibits in its growth, shows itself in the fruit. Both in inner energy and in outer form this expansion is often very great, indeed enormous. Since the enlargement generally occurs after fertilisation, it appears that the seed, having entered upon its definitive development, since it draws upon the juices of the whole plant for its growth, gives them a trend towards the seed-case. With the help of these juices the vessels become nourished, dilated, and often in the highest degree filled and expanded. From the foregoing argument it may be concluded that the purer kinds of gas take a great share in this process; this idea is confirmed by the experimental fact that the distended legumes of *Colutea* (bladder senna) contain pure air.

XI. CONCERNING THE IMMEDIATE ENVELOPES OF THE SEED

§ 82

In contrast to the expansion of the fruit, we find that the seed shows the extreme degree of contraction, while its interior is highly elaborated. It may be noticed in various cases that the seed transforms leaves into its immediate integuments, and that it adjusts them more or less to itself — generally, indeed, by its own energy moulding them closely to itself and quite altering their form. Since we have already seen many seeds de-

veloped from a single leaf, and enclosed therein, we need not be surprised that an individual seed-embryo should clothe itself in a leafy integument.

§ 83

In many winged seeds we can detect indications of the leafy seed-coat not being perfectly fitted to the seed — for example in the maple, the elm, the ash, and the birch. A very remarkable example of how the seed-embryo gradually draws together more expanded sheaths and adjusts them to itself, is offered to us by the three differing zones of heterogeneously formed seeds in the marigold. The outermost circle still preserves a shape akin to that of the leaves of the calyx, except that a seed-rudiment, straining the midrib, induces a curvature of the leaf, and the concavity is divided lengthways into two parts by a membrane. The succeeding circle has suffered further change, the wings of the little leaf, and the membrane, having quite disappeared. The form, on the other hand, is somewhat less elongated, and the seed-rudiment at the back shows itself more distinctly, while the little protuberances, which it bears, are more conspicuous. These two series appear to be either not at all, or only imperfectly, fertile. To these succeeds the third series; it has the authentic, strongly curved form, with a completely fitting coat, fully developed in all its variegation of ridges and excrescences. Once more we see here a vigorous contraction of an expanded leaf-like member, induced through the inner activity of the seed, just as we previously saw the petal contracted through the influence of the anther.

XII. RECAPITULATION AND TRANSITION

§ 84

And thus we have followed in the steps of Nature as scrupulously as we may; we have accompanied the outward form of the plant in all its transformations, from its development out of the seed, until the seed arose again; and without pretending to disclose the first springs of Nature's action, we have directed our attention to the manifestation of the forces whereby the plant gradually transforms one and the same organ. In order not to lose hold of the thread which we have once grasped, we have throughout considered the plant only as an annual, and we have noticed only the transformations of the leaves associated with the nodes, and have derived all forms from them. But, in order to give this essay the necessary completeness, we must now speak of the *buds* which lie concealed beneath each leaf, and develop under certain conditions, while, under other circumstances, they apparently disappear entirely.

XIII. CONCERNING THE BUDS AND THEIR DEVELOPMENT

§ 85

Nature bestows on each node the power to produce one or more buds. This happens in the neighbourhood of the leaves investing it, which appear to prepare for the formation and growth of the buds, and to cooperate in these processes.

§ 86

Upon the successive development of one node from another, and the formation of a leaf at each node with a bud in its neighbourhood, depends the first simple, gradually progressive reproduction of vegetables.

§ 87

It is well known that the activity of such a bud has a great similarity to that of the ripe seed; and that often in the bud, still more than in the seed, the whole form of the future plant may be recognised.

§ 88

Although a point from which a root will originate cannot be observed in the bud with equal facility, still it is really present there, as in the seed, and develops rapidly and easily, especially under moist conditions.

§ 89

The bud needs no cotyledons, since it is in connexion with its mother plant, which is already fully organised, and out of which, so long as it is in union with it, it obtains sufficient nourishment. If the bud is separated from its parent, it draws its supplies from the new plant on which it is grafted, or if, as a branch, it is planted in the earth, through the roots which are promptly produced.

§ 90

The bud consists of nodes and leaves, more or less developed, which are able to carry the future growth further. The lateral branches, which spring from the nodes of plants, may be regarded, then, as individual plantlets which take their stand upon the body of the mother, just as the latter is fixed in the earth.

§ 91

The seed and the lateral branch have frequently been compared and contrasted, and especially with so much insight and accuracy not long ago, that we may content ourselves with referring to this work with unconditional assent[136].

§ 92

We will cite only this much: that, in highly organised plants, Nature distinguishes buds and seeds clearly from one another, but, if we descend to the less complex, the distinction between the two seems to vanish, even to the sight of the keenest investigator. There are indubitable seeds and indubitable gemmae; but the point at which the truly fertilised seeds (isolated from the mother-plant by the operation of the two sexes) coincide with the gemmae (which are directly derived from the plant and detach themselves with no obvious cause) may indeed be apprehended by the intellect, but in no way by the senses.

§ 93

This being well pondered, we may venture to infer that the seeds — which are distinguished from the buds by their enclosed condition, and from the gemmae by the evident cause of their formation and detachment — nevertheless are closely related to both.

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136. GAERTNER, *De fructibus et seminibus plantarum.* Cap. I. [§ 92 also relates to this work by J. GAERTNER. On gemmae *see* vol. I, Stuttgart, 1788, *Introductio generalis,* Cap. I, p. xi, etc. (A.A.)]

XIV. FORMATION OF COMPOUND FLOWERS AND FRUITS

§ 94

We have hitherto sought to explain simple flowers, as likewise seeds which are enclosed in seed-vessels, through the transformation of nodal leaves. It will be found on closer investigation that in this case no buds develop — indeed the possibility of such a development is completely annulled. But in order to interpret both compound flowers and collective fruits borne around a single cone, a single spindle, a single disc, and so forth, we must call to our aid the development of buds.

§ 95

We frequently notice that stems, without preparing for some time, and holding themselves in reserve for a single flower, produce their flowers nodally, and often proceed thus continuously to their apex. But the phenomena thus displayed may be explained on the theory proposed above. All the flowers which develop from lateral buds are to be regarded as entire plants, which are set in the mother plant, as the mother plant is set in the earth. Since, under these circumstances, they receive purer saps from the nodes, so even the earliest leaves of the branchlets are indeed much more highly perfected than the first leaves of the mother plant which succeed the cotyledons; so much so that the formation of calyx and flower is often immediately possible.

§ 96

These same flowers, which are developed from lateral buds, would with increased nutrition have become branches, and would have experienced, in like manner, the fate to which the mother-stem, being in the same case, is obliged to submit.

§ 97

As now from node to node flowers of a similar kind develop, so we notice the same changes of the stem-leaves as we observed above in the gradual transition to the calyx. These stem-leaves gradually contract more and more, and finally dwindle almost completely. Since they then diverge more or less from leaf form, they are given the name of bracts. Correspondingly the stem becomes slenderer, the nodes become more closely set, and all appearances noticed above may be again traced here, except that no sharply defined inflorescence follows at the end of the stem, since Nature has exercised her right already from bud to bud.

§ 98

As we have now fully considered a stem adorned with a flower at each node, we shall be able to interpret a *collective inflorescence* quite easily, provided we call to our aid what has been said above about the origin of the calyx.

§ 99

Nature forms a *common calyx* from *many* leaves, which she crowds upon one another and collects round an axis. With the same strong growth impetus she modifies *an elongated stem,* as it were, in such a way that *all its*

buds are produced at once in the guise of flowers, thronged together in the closest possible proximity; each floret fertilises the seed-vessel already prepared below it. In this monstrous crowding, the nodal leaves do not invariably disappear; in the thistles the bract faithfully accompanies the floret, which develops from its associated bud. To illustrate this paragraph, the structure of the teasle (*Dipsacus laciniatus* L.) should be examined. In many grasses, each flower is accompanied by such a bract, which in this case is called the glume.

§ 100

In this way it will become apparent to us how it is that *the seeds developed by a composite flower are genuine buds, perfected and elaborated through the operation of the two sexes.* If we hold fast to this conception, and consider in this sense the growth and fructification of various plants, personal observation of a comparative kind will best convince us.

§ 101

It will then indeed not be difficult for us to explain the fructification of enclosed or exposed seeds, often collected round an axis, in the middle of a single flower. For it is all the same whether a single flower surrounds a complex fructification — the concrescent pistils absorbing the generative saps from the anthers of the flower and imbuing the seed with them — or whether each seed possesses its own pistil, its anthers, and its own corolla.

§ 102

We are convinced that with some practice there is no difficulty in explaining the multifarious forms of flowers and fruits in this way. It will admittedly be necessary for this purpose to operate with the conceptions of expansion and contraction, of compression and anastomosis, established above, as easily as with algebraic formulae, and to know how to use them in the right places. Now much depends upon the accurate observation and comparison with one another of the various stages which Nature follows, as well in the formation of genera, species, and varieties, as in the growth of a single plant; hence a collection of illustrations, arranged in order for this end, and an application of the botanical terminology of the various plant members, purely from this point of view, would be desirable, and certainly would not be without use. Two examples of proliferated flowers, giving strong support to the theories adduced, will, if demonstrated to the eye, afford crucial instances.

XV. PROLIFERATED ROSE

§ 103

All that we have hitherto sought to comprehend with the power of the imagination and intellect alone, is revealed with the greatest clearness in the example of a proliferated rose. Calyx and corolla are arranged and developed round the axis, but there is no *growth-inhibited*[137] seed receptacle in the centre, with the male and female reproductive organs placed *in orderly sequence* on it and around it; instead of this, the stalk, half *reddish* and half *greenish, elongates* again, while smaller petals develop upon it *in succession.*

137. This expression is used for Goethe's "zusammengezogen". (A.A.)

These are dark red and folded on themselves, and some of them bear traces of anthers. The stem goes on growing, and prickles are seen on it again. The coloured petals which follow are spaced apart; they become smaller and merge before our eyes into partly red and partly green stem-leaves. A succession of regular nodes is formed, from the buds of which arise little rosebuds, which are, however, imperfect.

§ 104

This example gives us thus a visible proof of the considerations previously advanced; namely that all calyces are floral leaves, only united by their margins. For here the calyx, regularly arranged round the axis, consists of five completely developed compound leaves of three or five leaflets, just like those that are borne by the branches of roses at their nodes.

XVI. PROLIFERATED PINK

§ 105

After we have studied this phenomenon carefully, another, which is to be observed in a proliferated pink, will seem to us almost more remarkable. We see a complete flower, the calyx of which has a double corolla above it, terminating in the midst with a seed-capsule, which is, however, imperfect. From the sides of the corolla, four complete new flowers develop, separated from the mother-flower by means of stems with three or more nodes; like the mother-flower, they have calyces, and are doubled, but not so much by means of individual petals as, either by means of corollas, the claws of which are concrescent, or, more usually, by means of petals, which are united in branchlet form, and clustered round a stalk. Notwithstanding this monstrous development, the filaments and anthers are present in some. The seed-vessels with styles are to be seen, and the placental region[138] has again grown out into leaves. In one of these flowers the seed-envelopes[139] were associated into a complete calyx, containing, in its turn, the rudiment of a complete double flower.

§ 106

We have in the rose a flower, as it were, half perfected, out of the centre of which a stem again shoots forth, bearing on itself new stem-leaves. So we find in this pink that — in addition to a normally formed calyx, a complete corolla, and *a pistil in the very centre — buds develop from the region of the petals,* and display actual branches and flowers. Both cases then show us that Nature, in the ordinary course, carries growth to a conclusion in the flower, and as it were sums it up, so that — in order the more quickly to reach the goal through the formation of seeds — she puts a stop to the possibility of an indefinite and gradual progression.

XVII. LINNAEUS' THEORY OF ANTICIPATION

§ 107

If I have stumbled here and there on this road, which one of my predecessors, who sought it moreover under the guidance of his great teacher,

138. This expression is used as a possible equivalent for GOETHE's "Receptakel der Samen". (A.A.)
139. The word "Samendecken" used here is translated "arilles" by SORET. (A.A.)

describes as full of terrors and perils[140]; if I have not levelled it sufficiently; nor succeeded in sweeping away all obstacles for my successors: I still hope not to have undertaken this labour fruitlessly.

§ 108

It is now time to take into consideration the theory which Linnaeus proposed for the interpretation of these very phenomena. The observations which prompted the present essay could not elude his keen glance. And if we are able to pass beyond the point at which he halted, we owe it to the common efforts of so many observers and thinkers, who have cleared away various impediments and have dissipated many prejudices. An exact comparison of his theory and that set forth above, would delay us too long. Experts will easily make the comparison for themselves, and to render it clear to those who have not previously attended to the subject, would involve too much detail. We will only indicate shortly what it was that prevented Linnaeus from progressing further and reaching the goal.

§ 109

He made his observations especially on trees — those complex and long-lived plants. He noticed that a tree in a large pot, supplied with excessive nourishment, produced branch after branch for several years in succession, while the same tree, cultivated in a smaller pot, rapidly brought forth flowers and fruit. He saw that the successional development in the former, suddenly became telescoped in the latter. Hence he called this process of Nature *Prolepsis,* an *Anticipation,* since the plant seemed to forestall six years in passing through the six steps to which we have alluded above. And so he worked out his theory in relation to the buds of trees, without paying any special regard to annual plants, since he must indeed have observed that to them it was less applicable. For according to his doctrine one needs to suppose that each annual plant must, intrinsically, have been destined by Nature to grow for six years, and that it all at once anticipates this long period of time in reaching the stage of flower and fruit, and thereupon dies.

§ 110

We, on the contrary, have first followed the growth of the annual plant; starting from this point, the application of the argument to perennial plants is easily made, since a bud shooting forth from the oldest tree is to be regarded as an annual plant, even if it develops directly out of a long-existent stem, and may itself be destined to a prolonged life.

§ 111

The second cause which hindered Linnaeus from advancing further, was that he visualised the various concentric zones of the plant body — the outer and the inner cortex[141], the wood, and the pith — too much as parts which acted equally, and were in an equal degree living and essential; and he as-

140. Ferber *in* Praefatione Dissertationis Secundae de Prolepsi Plantarum. [The full reference is Ferber, J. J. (1763): *Prolepsis plantarum, in* Linnaeus, C., *Amoenitates Academicae,* Lugduni Batavorum, vol. 6, No. cxx, *Praefatio,* p. 365. (A.A.)]

141. "Cortex" is used as a translation of "Rinde", but there is no exact English equivalent for this term, which, in Goethe's sense, includes epidermis, bark, cortex, phloem, and cambium. (A.A.)

cribed the origin of the flower- and fruit-members to these various zones of the stem, since these members, as well as the stem-zones, appear to enclose one another and to develop out of one another; but this was only a superficial observation, which will not endure closer scrutiny. For the outer cortex is not fitted for further development, and in long-lived trees it becomes, towards the outside, an indurated and isolated mass, as the wood becomes hardened towards the centre. In many trees the outer cortex is shed, and in others it may be removed without injuring them in the least. It cannot therefore bring forth either a calyx or any other living part of the plant. It is the second cortex[142] which possesses all the capacity for life and growth. If it is partially destroyed, to that degree growth is interrupted; it is the second cortex which, on careful consideration, we find produces all the exterior parts of the plant, either gradually in the stem, or all at once in the flowers and fruit. But only the subordinate function of producing the petals was ascribed to it by Linnaeus. The important production of the male staminal apparatus fell, on the other hand, to the wood; but it may easily be observed, on the contrary, that the wood itself is brought to a state of repose by its solidification, and, durable as it is, it is incapable of performing vital operations. The pith, finally, is supposed to accomplish the principal function, that of producing the female reproductive organs and a numerous progeny. The doubt which has been cast upon the great importance of the pith, and the reasons upon which this doubt is grounded, are to me weighty and decisive. The style and fruit present merely a superficial appearance of originating from the pith, because these structures, when they first make their appearance, are in a soft, ill-defined, pith-like, parenchymatous condition, and are crowded together just in the centre of the stem, where we are accustomed to see only the pith.

XVIII. SUMMARY

§ 112

I hope that the present attempt to interpret the metamorphosis of plants may contribute something to the solution of this enigma, and may give occasion for additional investigations and deductions. The scattered observations on which it is based have already been collected and arranged in order[143]; and it will soon be decided whether the step which we have here taken constitutes an approach to the truth. We will now as shortly as possible, summarise the principal results of the foregoing discourse.

§ 113

If we consider a plant in so far as it expresses its life force, we see that this force reveals itself in two directions — first, in *vegetative growth*, when it produces stem and leaves, and then in *reproduction,* which is completed in flower- and fruit-formation. If we inspect growth more closely, we see that, since the plant carries forward its existence from node to node and from leaf to leaf as it vegetates, a reproduction may be said to take place.

142. Goethe no doubt included what we now call the cambium in "die zweyte Rinde". (A.A.)

143. Batsch, Anleitung zur Kenntniss und Geschichte der Pflanzen. Theil I, Cap. 19. [For fuller reference *see* p. 70 (A.A.)]

This type of generation distinguishes itself, by the fact that it is *successive,* from the reproduction through the flower and fruit, which happens *suddenly;* being successive, it shows itself in a sequence of individual developments. This vegetative force, gradually expressing itself, bears an extremely close relation[144] to that which manifests itself once and for all in a conspicuous reproductive phase. A plant can be compelled, under various conditions, to *vegetate continuously,* while, on the other hand, one can *hasten the flowering phase.* The former result occurs when crude saps flood the plant; the latter when more rarefied forces predominate.

§ 114

When in this way we have named the *vegetative shoots* as representing successive reproduction, and *flower and fructification* as representing simultaneous reproduction, we have, in so doing, indicated the manner in which they both express themselves. A plant which *vegetates,* spreads itself more or less, and develops a stalk or stem; the intervals from node to node are generally noticeable; and its leaves spread out from the stem on all sides. On the other hand, a plant which *flowers* has contracted all its parts; increase in height and breadth is, as it were, arrested; and all its organs are in a highly condensed state and developed in close proximity to one another.

§ 115

When now the plant vegetates, blooms, or fructifies, so it is still *the same organs* which, with different destinies and under protean shapes, fulfil the part prescribed by Nature. The same organ which on the stem expands itself as a leaf, and assumes a great variety of forms, then contracts in the calyx — expands again in the corolla — contracts in the reproductive organs — and for the last time expands as the fruit.

§ 116

This operation of Nature is at the same time bound up with another — the *assembling of different organs round a centre,* according to definite numbers and proportions, which, however, in many flowers may often be, under certain circumstances, much modified and variously changed.

§ 117

In like manner in the *formation* of flowers and fruit an *anastomosis* operates, whereby the extremely delicate fructification parts, closely crowded against one another, are most intimately united, either throughout their whole duration, or only for part of this time.

§ 118

These phenomena of *approximation, arrangement round a centre*[145], and *anastomosis,* are not, however, peculiar to flowers and fructifications. We may, indeed, perceive something similar in cotyledons; and other plant members will give us ample material for similar considerations in the sequel.

§ 119

Just as we have now sought to explain the protean organs of the vege-

144. "Verwandt" misprinted "vewrandt" in the first issue of the first edition. (A.A.)

145. This expression is used for "Centralstellung", which is translated "concentrations" by SORET. (A.A.)

tating and flowering plant all from a single organ, *the leaf,* which commonly unfolds itself at each node; so we have also attempted to refer to leaf-form those fruits which closely cover their seeds.

§ 120[146]

It goes without saying that we must have a general term to indicate this variously metamorphosed organ, and to use in comparing the manifestations of its form; we have hence adopted the word *leaf.* But when we use this term, it must be with the reservation that we accustom ourselves to relate the phenomena to one another *in both directions.* For we can just as well say that a stamen is a contracted petal, as we can say of a petal that it is a stamen in a state of expansion. And we can just as well say that a sepal is a contracted stem-leaf, approaching a certain degree of refinement, as that a stem-leaf is a sepal, expanded through the intrusion of cruder saps.

§ 121

In the same way it may be said of the stem[147] that it is an expanded flowering and fruiting phase, just as we have predicated of the latter that it is a contracted stem.

§ 122

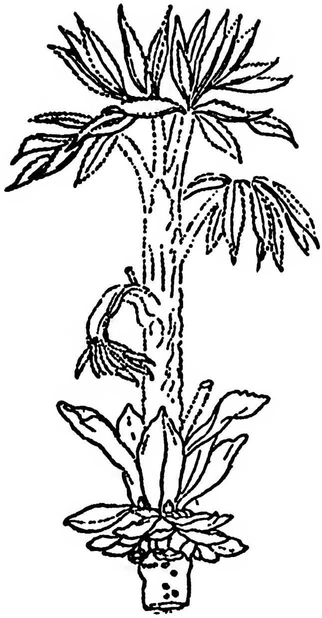
I have moreover at the conclusion of this essay considered the development of the *buds,* and through them have sought to explain compound flowers and unenclosed fruits.

§ 123

And in this way I have laboured to expound, as clearly and completely as I could, an idea which in my eyes has much that is convincing. If, in spite of all, it is still not fully in accordance with the evidence; if fault may still be found with it for some inconsistencies; and if the foregoing manner of interpretation does not seem to be universally applicable: so much the more will it be my duty to note all objections, and to treat this subject more exactly and circumstantially in the sequel, in order to make this way of looking at things more lucid, and to earn for it a more general approval than it can perhaps expect today.

146. The translation here given for the early part of this paragraph is made somewhat freely, in order to convey the meaning, which cannot be understood without reference to the previous paragraph. (A.A.)

147. One is tempted here and elsewhere to translate "Stengel" as "vegetative shoot," but to do so would modernise GOETHE's phraseology unduly. (A.A.)



THE OPENING OF A HORSE-CHESTNUT BUD (*Aesculus Hippocastanum* L.), PROBABLY AN ORIGINAL SKETCH BY GOETHE. — From SCHUSTER, J. (1924): *l.c.*, fig. 8, p. 100 (*See* p. 80 of text).

The

FRAGMENT

afterwards known as

Die NATUR

SKETCH BY GOETHE, SHOWING AT THE RIGHT, "FOLGE DER KNOTEN" (SEQUENCE OF NODES) AND LEFT, "ZUSAMMENZIEHUNG" (THE CONTRACTION FROM THE STEM-LEAVES TO THE CALYX; ON THIS CONTRACTION SEE P. 75 OF TEXT). — Sophien-Ausgabe, II, 13 (from TROLL, W., 1926): *l.c.*, p. 143. (These and other scribbled notes by GOETHE mentioned on p. 79 of text).

Prefatory Note: — A certain ode in prose, eventually called *Die Natur,* appeared in 1782, under the modest title, *Fragment,* in Part xxxii of the *Tiefurter Journal.* This was a magazine that circulated in manuscript among GOETHE'S associates attached to the Weimar court; all the contributions were anonymous. The question of the authorship of *Die Natur* has been studied by RUDOLPH STEINER[148], and the information which he has collected from letters and other sources may be summarised briefly here. Shortly after Part xxxii of the *Tiefurter Journal* appeared, GOETHE (writing to KNEBEL, who had assumed that the poem was his composition), definitely denied that he was the author, but added that it was written by someone with whom he had often talked on such subjects. His denial was confirmed by CHARLOTTE VON STEIN, who, in a letter to KNEBEL, asserted that the author was TOBLER. There the matter seems to have rested until forty-five years later, when GOETHE — sixteen years after TOBLER'S death — was reminded of the existence of the work by receiving a copy of it among papers which had belonged to the Duchess ANNA AMALIA; the script was that of an amanuensis whom he had employed in the seventeen-eighties. GOETHE seems at that distance of time to have forgotten his early disclaimer of the authorship of the *Fragment,* and he agreed to its being included among his published works. It appeared in the year after his death, under the title *Die Natur,* as the invocation to a volume containing some of his general scientific writings[149], but a letter, dating from the time that the manuscript came to light in 1828, was appended, in which GOETHE confessed frankly that he could not actually recall writing the poem. Despite CHARLOTTE VON STEIN'S explicit statement, STEINER believes that TOBLER was in no sense the real author, but was, as it were, a reporter, recording aphorisms which he had heard from GOETHE in conversation. TREVELYAN, also, regards the work as a product of GOETHE'S mind, if not of his pen[150]. It is difficult to accept these conclusions unreservedly, since little external evidence is presented for them, and the internal evidence points in the other direction. *Die Natur* seems too consistent and too closely integrated to have been put together piecemeal and at secondhand. A sub-title, *Aphoristisch,* which did not occur in the original, was added, presumably by GOETHE, when the work was to be printed. Its introduction was regrettable, since it seems to suggest that the stanzas are discrete entities, loosely assembled. This is what they might indeed have been if TOBLER had merely recorded disconnected dicta as they fell from GOETHE'S lips; but to think of the ode, as it stands, as a collection of aphorisms does less than justice to its unity and coherence. Moreover TOBLER himself seems to have been the very man to have conceived and written such a poem. He is described as a scholar, steeped in learning and philosophy, with a strong bent towards the Greek

148. STEINER, R. (1892): *Zu dem "Fragment" über die Natur.* Schriften der Goethe-Gesellschaft, vol. 7, pp. 393-8.
149. GOETHE, J. W. VON (1833): *Werke,* vol. 50 (*Nachgelassene Werke,* vol. 10), Cotta, Stuttgart and Tübingen, pp. 1-7; it has been reprinted in Sophien-Ausgabe, Abt. II, Bd. 11, pp. 5-9; TROLL ed., pp. 107-9; etc.
150. TREVELYAN, H. (1941): *Goethe and the Greeks.* Cambridge, England; p. 113, footnote 3.

way of life. He was a Switzer, but in 1781 he spent six months in Weimar, where GOETHE had considerable contact with him, and became much attached to him. Before coming to Weimar, TOBLER had rendered SOPHOCLES into German verse, and, while he was there, he stimulated interest in the classics, especially by his translations of AESCHYLUS and EURIPIDES[151]. Since GOETHE thought highly of these versions, it may be concluded that TOBLER had a genuine poetic gift. He, like GOETHE, is known to have concerned himself with the Orphic hymns[152], which are said to date from the fourth century A.D., and among which there is one — *To Nature*[153] — which evidently played a part in inspiring *Die Natur*[154].

In *Die Natur* STEINER traces the germs of much of GOETHE's later scientific work, but this cannot be taken as a proof that GOETHE wrote the poem himself; it may mean, on the contrary, that TOBLER exerted a powerful influence upon his great contemporary.

Whatever conclusion expert students of GOETHE and TOBLER may eventually reach as to its authorship, *Die Natur* will remain of permanent interest to biologists, since, on GOETHE's own showing[155], it crystallises for us the phase through which his scientific philosophy was struggling in the years immediately preceding the experience of happy enlightenment which found expression in the *Metamorphose*[156].

A translation of *Die Natur* by T. H. HUXLEY formed the opening of the first volume of the British journal, *Nature*[157]; it was reprinted in the same periodical for the centenary of GOETHE's death[158]. Another translation, which HUXLEY regarded as an improvement upon his own[159], was made by BAILEY SAUNDERS[160]. The rendering which here follows the reprint of the text, owes much to both these versions.

The ode, as published in GOETHE's works, differs in minor points from the original, as here reprinted from the *Tiefurter Journal* after STEINER[161]. GOETHE's version includes one additional sentence[162].

151. TREVELYAN, H. (1941): *l.c.*, pp. 106 and 113.
152. PLASSMANN, J. O. (1928): *Orpheus. Altgriechische Mysteriengesänge.* Jena; p. iv.
153. A translation of this will be found in TAYLOR, T. (1896): *The Mystical Hymns of Orpheus.* London; pp. 28-33. The first edition of this work was published in 1787.
154. TREVELYAN, H. (1941): *l.c.*, pp. 63-4, 113-4, etc.
155. Letter to Kanzler F. T. A. H. VON MUELLER, May 24, 1828, Sophien-Ausgabe, Abt. II, vol. 11, pp. 9-12; TROLL ed., p. 447.
156. *See* also p. 80.
157. *Nature*, vol. 1, 1869, pp. 9-11.
158. *Nature*, vol. 129, 1932, pp. 425-6.
159. *Nature*, vol. 51, 1894, p. 1.
160. *The Maxims and Reflections of Goethe*, translated by [T.] BAILEY SAUNDERS, London, 1893, pp. 207-13.
161. STEINER, R. (1892): *l.c.*, pp. 258-61.
162. This sentence is given in footnote 164.

Original Text of the 'Fragment'*

Natur! Wir sind von ihr umgeben und umschlungen — unvermögend aus ihr herauszutreten, und unvermögend tiefer in sie hinein zu kommen. Ungebeten und ungewarnt nimmt sie uns in den Kreisslauf ihres Tanzes auf und treibt sich mit uns fort, biss wir ermüdet sind und ihrem Arme entfallen.

Sie schaft ewig neue Gestalten; was da ist war noch nie, was war kommt nicht wieder — Alles ist neu und doch immer das Alte.

Wir leben mitten in ihr und sind ihr fremde. Sie spricht unaufhörlich mit uns und verräth uns ihr Geheimniss nicht. Wir wirken beständig auf sie und haben doch keine Gewalt über sie.

Sie scheint alles auf Individualität angelegt zu haben und macht sich nichts aus den Individuen. Sie baut immer und zerstört immer und ihre Werkstätte ist unzugänglich.

Sie lebt in lauter Kindern, und die Mutter, wo ist sie? — Sie ist die einzige Künstlerinn: aus dem simpelsten Stoffe zu den grössten Contrasten: ohne Schein der Anstrengung zu der grössten Vollendung — zur genausten Bestimmtheit, immer mit etwas weichem überzogen. Jedes ihrer Werke hat ein eigenes Wesen, iede ihrer Erscheinungen den isolirtesten Begrif und doch macht alles eins aus.

Sie spielt ein Schauspiel: ob sie es selbst sieht wissen wir nicht, und doch spielt sie's für uns die wir in der Eke stehen.

Es ist ein ewiges Leben, Werden und Bewegen in ihr und doch rükt sie nicht weiter. Sie verwandelt sich ewig und ist kein Moment Stillestehen in ihr. Für's bleiben hat sie keinen Begrif und ihren Fluch hat sie an's Stillestehen gehängt. Sie ist fest. Ihr Tritt ist gemessen, ihre Ausnahmen selten, ihre Geseze unwandelbar.

Gedacht hat sie und sinnt beständig; aber nicht als ein Mensch sondern als Natur. Sie hat sich einen eigenen allumfassenden Sinn vorbehalten, den ihr niemand abmerken kann.

Die Menschen sind all in ihr und sie in allen. Mit allen treibt sie ein freundliches Spiel, und freut sich ie mehr man ihr abgewinnt. Sie treibt's mit vielen so im verborgenen dass sie's zu Ende spielt ehe sie's merken.

Auch das unnatürlichste ist Natur. Wer sie nicht allenthalben sieht, sieht sie nirgendwo recht.

Sie liebet sich selber und haftet ewig mit Augen und Herzen ohne Zahl an sich selbst. Sie hat sich auseinander gesezt um sich selbst zu geniessen. Immer lässt sie neue Geniesser erwachsen unersättlich sich mit zu theilen.

Sie freut sich an der Illusion. Wer diese in sich und andern zerstört, den straft sie als der strengste Tyrann. Wer ihr zutraulich folgt, den drükt sie wie ein Kind an ihr Herz.

Ihre Kinder sind ohne Zahl. Keinem ist sie überall karg, aber sie hat Lieblinge an die sie viel verschwendet und denen sie viel aufopfert. An's Grosse hat sie ihren Schuz geknüpft.

Sie sprizt ihre Geschöpfe aus dem Nichts hervor, und sagt ihnen nicht woher sie kommen und wohin sie gehen. Sie sollen nur laufen. Die Bahn kennt sie.

Sie hat wenige Triebfedern aber nie abgenuzte, immer wirksam immer manichfaltig.

Ihr Schauspiel ist immer neu weil sie immer neue Zuschauer schaft. Leben ist ihre schönste Erfindung, und der Todt ist ihr Kunstgrif viel Leben zu haben.

Sie hüllt den Menschen in Dumpfheit ein und spornt ihn ewig zum Lichte. Sie macht ihn abhängig zur Erde, träg und schweer und schüttelt ihn immer wieder auf.

Sie giebt Bedürfnisse weil sie Bewegung liebt. Wunder, dass sie alle diese Bewegung mit so wenigem erreichte. Jedes Bedürfniss ist Wohlthat. Schnell befriedigt, schnell wieder erwachsend. Giebt sie eins mehr so ist's ein neuer Quell der Lust. Aber sie kommt bald in's Gleichgewicht.

* As reprinted from the Tiefurter Journal, Pt. xxxii, 1782, by R. Steiner (1892), *l.c.*, pp. 258-261.

Sie sezt alle Augenblike zum längesten Lauf an und ist alle Augenblike am Ziele.

Sie ist die Eitelkeit selbst; aber nicht für uns denen sie sich zur grössten Wichtigkeit gemacht hat.

Sie lässt iedes Kind an sich künsteln, ieden Thoren über sie richten, tausend stumpf über sie hingehen, und nichts sehen und hat an allen ihre Freude und findet bey allen ihre Rechnung.

Man gehorcht ihren Gesezen, auch wenn man ihnen widerstrebt, man wirkt mit ihr auch wenn man gegen sie wirken will.

Sie macht alles was sie giebt zur Wohlthat, denn sie macht es erst unentbehrlich. Sie säumet dass man sie verlange, sie eilet, dass man sie nicht satt werde.

Sie hat keine Sprache noch Rede, aber sie schaft Zungen und Herzen durch die sie fühlt und spricht.

Ihre Krone ist die Liebe. Nur durch sie kommt man ihr nahe. Sie macht Klüfte zwischen allen Wesen und alles will sich verschlingen. Sie hat alles isoliret um alles zusammen zu ziehen. Durch ein paar Züge aus dem Becher der Liebe hält sie für ein Leben voll Mühe schadlos.

Sie ist alles. Sie belohnt sich selbst und bestraft sich selbst, erfreut und quält sich selbst. Sie ist rauh und gelinde, lieblich und schröklich, kraftlos und allgewaltig. Alles ist immer da in ihr, Vergangenheit und Zukunft kennt sie nicht. Gegenwart ist ihr Ewigkeit. Sie ist gütig. Ich preisse sie mit allen ihren Werken. Sie ist weise und still. Man reisst ihr keine Erklärung vom Leibe, truzt ihr kein Geschenk ab, das sie nicht freywillig giebt. Sie ist listig, aber zu gutem Ziele und am besten ist's ihre List nicht zu merken.

Sie ist ganz und doch immer unvollendet. So wie sie's treibt, kann sie's immer treiben.

Jedem erscheint sie in einer eigenen Gestalt. Sie verbirgt sich in tausend Namen und Termen und ist immer dieselbe.

Sie hat mich herein gestellt, sie wird mich auch heraus führen. Ich vertraue mich ihr. Sie mag mit mir schalten. Sie wird ihr Werk nicht hassen. Ich sprach nicht von ihr. Nein was wahr ist und was falsch ist alles hat sie gesprochen Alles ist ihre Schuld, alles ist ihr Verdienst.

Translation of the 'Fragment'

— Afterwards called by GOETHE 'Nature: Aphoristic' —

Nature! We are encircled and enclasped by her — powerless to depart from her, and powerless to find our way more deeply into her being. Without invitation and without warning she involves us in the orbit of her dance, and drives us onward until we are exhausted and fall from her arm.

Eternally she creates new forms. What now is, never was in time past; what has been, cometh not again—all is new, and yet always it is the old.

We live in the midst of her, and yet to her we are alien. She parleys incessantly with us, and to us she does not disclose her secret. We influence her perpetually, and yet we have no power over her.

It is as if she founded all things upon individuality, and she recks nothing of individuals. She builds for ever, and destroys for ever, and her atelier is inaccessible.

She lives in her children alone, and the mother, where is she? — She is the sole artist; from the simplest material she passes to the extremest diversity; with no hint of strain she arrives at the fullest consummation — at the exactest precision, always veiled in a certain obscurity. Each thing she makes has its own being, each of her manifestations is an isolated idea, and yet they all are one.

She acts a play; whether she witnesses it herself we know not, and still she acts it for us — for us whose view is but sidelong[163].

In her there is eternal life, eternal coming-to-be, and eternal movement, and yet she travels no further. She transmutes herself for ever, and for no moment does she come to rest. To abide unchanged is not in her scheme of things, and she has set her curse upon stagnation. She is constancy itself. Her pace is measured, she seldom endures exceptions, and her laws are immutable.

Pondering and meditation are perpetual in her; but it is not as humanity, but as Nature, that she muses. She reserves for herself an all-embracing mode of thought which none can penetrate.

All mankind is in her, and she is in them all. In friendliness she plays with each one, and rejoices the more he prevails against her. With many she deals so secretly that she plays the play out to the end before they are aware of it.

Even the extreme of the unnatural is Nature[164]. None can see her rightly anywhere who does not see her everywhere.

She loves her very self, and unto herself she cleaves eternally with countless eyes and hearts. She has set herself asunder, that she may be to herself the sources of gladness. Continually she produces new sentient beings who can enjoy her; inexhaustibly she communicates herself.

She takes delight in illusion. He who shatters it in himself and in other men, him she chastises as the harshest tyrant. He who follows her trustingly him she gathers to her heart like a babe.

Her children are innumerable. To none is she at all times miserly, but she has her favoured darlings for whom she is prodigal and to whom she dedicates much. To greatness she accords her protection.

She volleys forth her creations from nothingness, and tells them not whence they come nor whither they go. They have only to run the course she sets; knowledge of the way is hers alone.

Her springs of action are few, but they are never outworn; powerful are they always, and always rich in diversity.

Her drama is for ever fresh, since she continually creates new spectators. Life is her loveliest invention, and Death is her device for ensuring plenitude of Life.

She shrouds man in misty dark, and goads him incessantly towards the light; she makes him earthbound, inert, and ponderous, and ever and again she startles him out of sleep.

She arouses cravings, since she loves to incite. Marvellous it is that she achieves

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163. This rendering, though not literal, conveys what I believe to be the sense of "die wir in der Eke stehen" (A.A.).

164. The sentence, "Auch die plumpste Philisterey hat etwas von ihrem Genie" (Even the crassest unenlightenment has in it something of her genius), was added here when the poem was printed among GOETHE's works.

this incitement with so little. Each longing which she instils is a benison; quickly appeased, quickly it springs up anew. If ever she gives more, it is a fresh fount of desire; but the balance is soon redressed.

Every moment she sets forth on the longest pilgrimage, and every moment she is at the end where she would be.

She is vanity itself, but not for us, for whom she becomes the soul of seriousness.

She allows every child to work its will upon her, every fool to sit in judgment upon her, and she permits thousands to pass over her in blind apathy; but she rejoices in them all, and from all she reaps her harvest.

We obey her laws even in resisting them; we work with her, even when our desire is to work against her.

Everything she gives becomes a blessing, since she begins by making it a necessity. She tarries, that we may long for her; she hastens, that we may not tire of her.

She has no speech nor language, but she creates tongues and hearts, through which she feels and utters.

Her ultimate perfection is Love; it is only through Love that she can be approached. She sets chasms between all beings, and in them all is the urge to interfuse. She has created severance, in order to draw all things together. She holds that a few draughts from the chalice of Love are a requital for a life full of care.

She is the Whole. To herself she metes out reward and punishment, delight and torment. She is austere and tender; charming and horrible; impotent and omnipotent. All things are evermore in her. Past and future are nought to her. The present is her eternity. Gracious is she. I laud her with all her works. She is wisdom and tranquillity. No answer to life's riddle can be wrested from her, no gift can be extorted from her which she does not offer of her own free will. She is full of finesse, but her goal is good, and it is best to avert the mind from her craft.

She is perfectly whole, and yet always incomplete. Thus, as she now works, she can work for ever.

To each man she appears as befits him alone. She cloaks herself under a thousand names and terms, and is always the same.

She has brought me hither, and will also lead me hence. I yield myself to her in trust. She may do with me as she pleases. She will feel no hatred towards her work. It is not I myself who have spoken concerning her. No—it is she who has said everything, both what is true and what is false. She is guilty of All, and hers is the honour of the Whole.

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(Issued Autumn 1946)

MERRILLEANA

Elmer D. Merrill

MERRILLEANA

A Selection from the General Writings

of

ELMER DREW MERRILL, SC.D., LL.D.

Arnold Professor of Botany, Harvard University; former Director, Bureau of Science, Manila; Dean, College of Agriculture, University of California; Director, New York Botanical Garden; Administrator of Botanical Collections, Harvard University, and Director, Arnold Arboretum

Drs. E. D. Merrill (*right*) and E. B. Copeland (*left*) with Henry Osgood (*centre left*) and Joseph French (*centre right*), the members of a bachelor's mess in Manila (*ca.* 1905). — *Photograph courtesy of Dr. Copeland.*

The Buildings of the Bureau of Science in Manila, Philippine Islands (*ca.* 1916). Dr. Merrill was director of this institution from 1919 to 1923, after having been associated with the bureau since its original organization in 1902. The buildings were constructed in 1905 and housed practically all of the scientific activities of the Philippine Government outside of meteorology. Dr. Merrill with Dr. Copeland were the first two employees to move into the new building in 1906. — The loss of the buildings with almost all their contents as a result of the fighting during the reoccupation of Manila in 1945 forms a most tragic episode in the history of science and not less in Dr. Merrill's life (*cf.* Chron. 9: 191, 1945). The way he continued to work after the intelligence of the destruction of these collections reached him may well be an inspiration to those who have seen part or all of their life work go up in flames during the conflagrations caused by the Second World War. (Ed. C. B.)

EDITORS' FOREWORD

Not long ago, when two Swedish botanists visited Harvard, a group of American colleagues was introduced by comparing each of them to a Swedish colleague of the past. The awarding of cognomina, like those taken in former times by the members of the Academia Leopoldino-Carolina, will always, of course, be symbolic. Coming to Dr. MERRILL *it seemed logical to introduce him as the American* LINNAEUS. *True,* LINNAEUS *played a unique rôle in the history of botany and zoology; none of us of the present day can be compared to him, in the literal sense of the word. If we analyze* LINNAEUS' *rôle in botany we find that his special qualities were* (1) *an unsurpassed knowledge of flowering plants, particularly those of far-off regions,* (2) *an outstanding originality and ability in methodological and administrative work, and* (3) *a ready desire to assist his fellow workers the world over, in an often astonishingly effective way, whenever there was the slightest possiblity of doing so. No one amongst us at present attains those qualities to the same degree and extent as Dr.* MERRILL.

On the occasion of his seventieth birthday anniversary the editors of CHRONICA BOTANICA *wanted to render a fitting homage to their distinguished co-editor. He has given us a large number of discussions and essays of a broad general nature and of permanent interest. Scattered through numerous publications, often distinguished by an admirable brevity and succinctness, they set a standard for those less alert and penetrating minds so often prone to bury small thoughts under ponderous verbosity. So we take great pleasure in bringing together in the present volume an authorized selection from the principal, general writings and essays of the American* LINNAEUS, *for, as* MUNTING *et al.* (1678) *wrote in* GABBEMA'S *"Friesche Lustgaarde":*

> *Soo oit de dankbaerheit een eerlijk hert verpligte*
> *Aen't schrandere vernuft en rappe neerstigheyt*
> *Van die, wiens vlugge pen d'onweetendheit deed swigten*
> *Soo sie'k geleerd Oraakel, uw roem ten top geleid . . .*
> *Die 't niet verstaat, doorlees dit boek*
> *Hier vint gij Naarstig Onderzoek*
> *Daar 't al voor open komt te leggen . . .*
> *Volgt maat en trant van zijn gedicht*
> *Plant, Poot, en Ent naar dit Bericht . . .*

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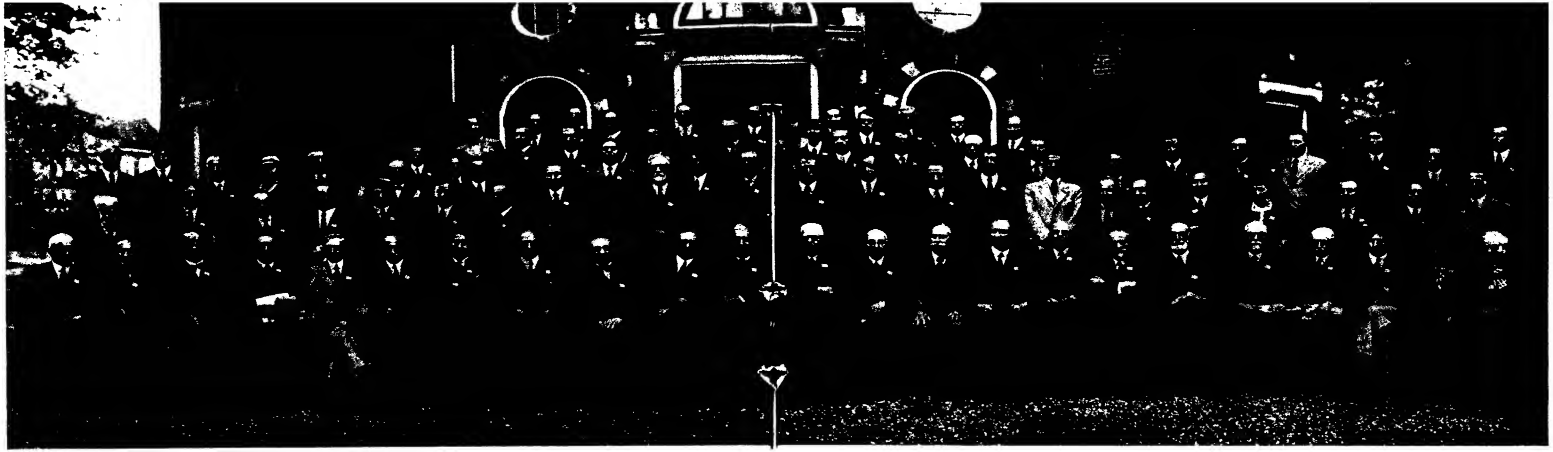
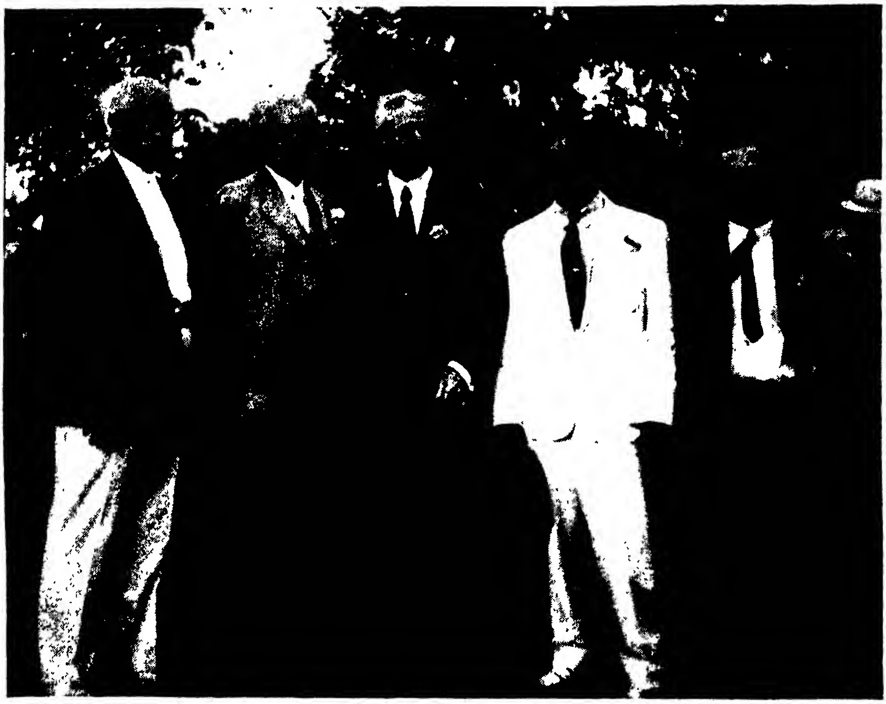


Dr. E. D. Merrill in the center of a group of colleagues from all over the world; official photograph of the members of the Section for Plant Taxonomy, at the Sixth International Botanical Congress, Amsterdam, September 1935 (*cf.* Chron. 2: 35, 1936). — Front row, left to right: J. Holmboe, K. Domin, J. Podpěra, R. Maire, J. M. Greenman, J. Hutchinson, W. Robyns, A. W. Hill, H. Harms, E. D. Merrill, R. E. Fries, A. A. Pulle, L. Diels, A. Rehder, W. L. Jepson, C. A. Weatherby, H. Winkler, H. Handel Mazzetti, H. Lindberg, H. W. Pugsley, T. G. Tutin, Miss Dyal, Miss A. Eastwood; Second row: A. Guillaumin, S. Bloembergen, F. Pellegrin, H. Prat, P. Buwalda, A. W. Exell, F. A. Mendonça, L. R. Parodi, P. J. Eyma, A. S. Hitchcock, Miss M. L. Green, T. A. Sprague, W. James, E. P. Killip, H. J. Lam, A. C. Smith, F. A. McClure, N. D. Simpson, J. Mattfeld, F. Verdoorn, Mrs. F. Verdoorn, G. Cufodontis, Th. Just, N. Malta: Third row: N. A. Stojanoff, W. B. Turrill, T. E. Hazen, Mrs. A. Christensen, C. Christensen, ... E. Wilczek, ..., W. A. Goddijn, J. de Carvalho e Vasconcellos, H. Humbert, S. J. van Ooststroom, Th. Reinhold, J. Th. Henrard, Miss J. Th. Koster, A. J. G. H. Kostermans, C. V. B. Marquand, S. P. Agharkar, A. D. Cotton, E. F. Warburg, M. Fries, H. Gams, F. Knoll, K. H. Rechinger, F. P. Jonker, Woon Young Chun, J. Lanjouw; Back row: ......, A. Eig, R. Pampanini, B. P. G. Hochreutiner, J. Burtt-Davy, ..., Mrs. A. Castellanos, Miss E. Björklund, A. Castellanos, J. Th. Howell, ..., H. Sleumer, H. Uittien.

PLATES and ILLUSTRATIONS



Dr. MERRILL and other nestors of North American Botany at the opening of the Fairchild Botanical Garden, Coconut Grove, Florida, March 1938. — From right to left, Dr. E. D. MERRILL, Colonel R. H. MONTGOMERY, Dr. W. T. SWINGLE, Dr. L. H. BAILEY, Dr. DAVID FAIRCHILD.

Illustrissimi Auctoris Vita

1876 Born at East Auburn, a suburb of Auburn, Maine, on October 15, the son of DANIEL C. and MARY A. (NOYES) M., a direct descendant of NATHANIEL MERRILL, the first immigrant of that name, who settled at Ipswich (Newburyport), Mass. in 1635. The MERRILL (originally DE MERLE) family is of French Huguenot descent.

1894 Graduated from the Edward Little High School, Auburn, Maine. Enters the University of Maine.

1898 B. Sc., University of Maine; Valedictorian.

1899 First paper ("Notes on Maine Plants") published, in Rhodora, Vol. 1.

1898/99 Assistant, Dept. of Natural Science, University of Maine.

1899/02 Assistant Agrostologist, U. S. Dept. of Agriculture, Washington. Many papers on the classification of American grasses published.

1900/01 Student at George Washington University, Medical School.

1902/03 Botanist, Bureau of Agriculture and Forestry, Manila, P. I.

1902 Visits to Ceylon and Singapore. First trip to Buitenzorg.

1903 "Dictionary of the Plant Names of the Philippine Islands" published.

1903 E. B. COPELAND, H. N. WHITFORD and A. D. E. ELMER added to the botanical staff at Manila.

1903/05 Botanist, Bureau of Government Laboratories, Manila, P. I.

1904 M.Sc. degree awarded by the University of Maine.

1904 "New and Noteworthy Philippine Plants" series initiated.

1905 Review of BLANCO's plant species published.

1906/23 Botanist, Bureau of Science, Manila.

THE PHILIPPINE

JOURNAL OF SCIENCE

EDITED BY

PAUL C. FREER, M. D., PH. D.

CO-EDITORS

RICHARD P. STRONG, PH. B., M. D.
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E. D. MERRILL, M. S.

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VOLUME I

1906

WITH 245 PLATES, 40 FIGURES, 23 CHARTS, 2 MAPS, AND 6 TABLES

MANILA
BUREAU OF PRINTING
1906

The Philippine Journal of Science was established in 1906, chiefly at the suggestion of Dr. MERRILL who was dissatisfied with the form which had been adopted for its publication by the Bureau of Government Laboratories, the organization which preceded the Bureau of Science. He felt that a periodical would cost no more than the uncoordinated, free bulletins, that it could be placed strictly on an exchange and subscription basis, and that it would hence be a much more important vehicle for building up the library of the Bureau of Science. In 1906 it was a pioneer adventure to establish a technical periodical under government auspices on a subscription basis. Later the *Journal of Agricultural Research* (1913) and other government publications followed the pattern set by the *Philippine Journal of Science* in the editing of which Dr. MERRILL continued to play an active part until he left Manila sixteen years later. (Ed. C. B.)

1906 Mount Halcon Expedition, one of a great many exploring expeditions in the Philippines between 1902 and 1923.

1906/23 *Philippine Journal of Science* established. This was greatly developed and in part edited by Dr. MERRILL until he left Manila in 1923.

1907 Married MARY AUGUSTA SPERRY, Manila, P. I. — Children: LYNNE, DUDLEY SPERRY, WILMANS NOYES (dec.), ANN.

1907/08 First leave while in Manila: nearly three months spent in London, engaged in botanical work, with shorter visits to Leiden, Berlin, Geneva, and Florence.

1912/17 Associate Professor of Botany, University of the Philippines (half-time appointment).

1912 "Flora of Manila" published.

1913 C. B. ROBINSON's Expedition to Amboina planned.

1913 Work on the Guam flora initiated.

1914 Second visit to Buitenzorg, to settle matters concerned with the death of C. B. ROBINSON in Amboina.

1914 Enumeration of Guam plants published.

1914/15 Second leave while in Manila, spent in Washington, D. C.

1915 Work on the Borneo flora initiated.

1916/17 Collecting trips in Kwantung Province, China.

1917/19 Professor of Botany, University of the Philippines (half-time appointment).

1917 "An Interpretation of Rumphius' Herbarium Amboinense" published.

1918 "Species Blancoanae" published.

1918 First of many papers on the flora of China published.

1919 Acting Director, Bureau of Science, Manila.

1919 Corresponding Member, Malayan Branch, Royal Asiatic Society, Singapore.

1919/23 Director, Bureau of Science, Manila.

1919/23 Professorial Lecturer, University of the Philippines.

1920 Honorary Consulting Botanist, Bishop Museum, Honolulu.

1920 Collecting trip to Anwhei and Chekiang Provinces, China.

1920/21 Third leave, attended First Pan Pacific Congress at Honolulu, remaining time spent in California.

1921 "Bibliographic Enumeration of Bornean Plants" published.

1921 First of many papers on the Hainan flora published.

1922 Fellow, American Academy of Arts and Sciences.

1922 There were at this time 275,000 mounted specimens in the herbarium of the Bureau of Science, Manila, which was initiated twenty years earlier, the first specimens being those collected in Manila in 1902 by E. D. MERRILL.

1923 Publication of the "Enumeration of Philippine Flowering Plants" commenced.

1923 First important papers on phytogeography published.

1923 Member, National Academy of Sciences, Washington, D. C.

1924 "Bibliography of Polynesian Botany" issued.

1924 Correspondent, Muséum National d'Histoire Naturelle, Paris.

1924 Correspondent, Naturhistorisches Museum, Vienna.

1924 First paper on the Indo-China flora published.

1924 Council Member, Save-the-Redwoods League.

1924/29 Professor of Agriculture and Dean, College of Agriculture, University of California, and Director, Agricultural Experiment Station.

1925 *Hilgardia* established.

1925 Corresponding Member, Deutsche Botanische Gesellschaft.

1926 Sc.D., University of Maine.

1926 "Enumeration of Philippine Flowering Plants" finished.

At a meeting of the Board of Managers of
The New York Botanical Garden
held July 29, 1935, the following resolution was unanimously adopted:

Whereas,

Dr. Elmer Drew Merrill

Director of The New York Botanical Garden since January 1, 1930, has tendered to the Board of Managers of the Garden his resignation of this post, effective on October 1, 1935, in order to accept appointment as Professor of Botany and Administrator of Botanical Collections at Harvard University, therefore be it

Resolved, by the Managers of The New York Botanical Garden, that they are highly appreciative of the very efficient services that Dr. Merrill has rendered to the Garden during his tenure of office of somewhat more than five and a half years; that they have noted, in particular, the promptness and foresight with which he has secured for the Garden assignment of workers and appropriations of funds by various emergency relief and employment bureaus for general assistance and for much needed repairs and improvements:

That they have observed with gratification the development of horticultural features which have made the Garden increasingly attractive to the general public; that they have noted, with wonder and admiration, Dr. Merrill's ability, in spite of exacting executive duties, to continue his systematic studies of Oriental plants, studies which have made him

The Outstanding Leader in This Field

that they have observed with satisfaction the Honors that have been bestowed upon him by American, foreign and international scientific organizations.

While the Managers greatly regret his going, they extend to Doctor Merrill their very best wishes for happiness in his new field and for a most successful continuation of his distinguished career.

Henry W. de Forest

President

RESOLUTION OF THE BOARD OF MANAGERS OF THE NEW YORK BOTANICAL GARDEN, JULY 29, 1935

1927 "Enumeration of Hainan Plants" published.

1927/28 Director, California Botanical Garden, Los Angeles.

1929 Corresponding Member, Peking Society of Natural History.

1930 Vice President, Section of Nomenclature, Fifth International Botanical Congress, Cambridge, England.

1930 First important paper on ethnobotany issued.

1930/31 American Editor of "An International Botanical Address Book" (published in 1931).

1930/35 Director, New York Botanical Garden.

1930/35 Professor of Botany, Columbia University.

1931 Chairman, Section G, American Association for the Advancement of Science; Acting President, A. A. A. S. Meeting, December 1931.

1931 Member, Latin American Committee of Selection, Guggenheim Foundation.

1931 *Brittonia* established.

1931/35 Trustee, Horticultural Society of New York.

1932 Ehrenmitglied, Deutsche Botanische Gesellschaft.

1932 Member, American Philosophical Society.

1932 Member, Educational Advisory Board, Guggenheim Foundation.

1932 Correspondent, Philadelphia Academy of Natural Sciences.

1933 Foreign Member, Linnean Society of London.

1934 President, Botanical Society of America.

1934 First paper on the Sumatra flora published.

1935 Member, Board of Managers, New York Botanical Garden.

1935 President, International Union of Biological Sciences.

1935 Honorary Member, Netherlands Botanical Society.

1935 Honorary Member, Royal Horticultural Society of London.

1935 President, Section of Taxonomy and Nomenclature, Sixth International Botanical Congress, Amsterdam.

1935 Appointment to Arnold Professorship of Botany, Director of the Arnold Arboretum, and Administrator of Botanical Collections, Harvard University.

1935 Commentary on Loureiro's "Flora Cochinchinensis" published.

1935 Advisory Editor, Chronica Botanica. Contributed first article to first volume ("International Coöperation among Botanists").

1936 Honorary Member, Japanese Botanical Society.

1936 LL.D., University of California.

1936 Sc.D., Harvard University.

1936 Official guest of Harvard University at the Tercentenary celebration.

1936 Member, Board of Managers, Barro Colorado Biological Station.

1937 President, New England Botanical Club.

1937 "Polynesian Botanical Bibliography (1773-1935)" published.

1937 Académico Honorario, Universidad Nacional de La Plata.

1938 Honorary Member, Kon. Nederlandsch Aardrijkskundig Genootschap.

1938 Trustee, Massachusetts Horticultural Society.

1938 "A Bibliography of Eastern Asiatic Botany" (with E. H. Walker) published.

1939 Recipient of the Linnean Gold Medal, Linnean Society of London.

1939 Médaille d'Or awarded by the Société Nationale d'Acclimatation.

1939 First of many papers on the flora of New Guinea and the Solomon Islands published.

1939 Corresponding Member, Institut Genevois.

1940 Associate, Muséum National d'Histoire Naturelle, Paris.

1940 President, Fairchild Tropical Garden.

1941 Honorary Member, Royal Agricultural and Horticultural Society of India.

1941 First paper on the flora of Burma published.

1941 *Arnoldia* established.

1942 Work on *Index Rafinesquianus* initiated.

1942 *Sargentia* established.

1942/45 Much work concerned with the identification of botanical material sent in by service men scattered from Upper Burma to New Caledonia. Lectured every two months to each incoming group of trainees in the intensive refresher course on tropical medicine, Army Medical School, Washington, D. C., on poisonous and emergency food plants.

1943 "Emergency Food Plants" published by the U. S. War Department.

1943/45 Consultant to the Secretary of War.

1944 Work on problems in nomenclature of BARTRAM, AMOS EATON and MUHLENBERG initiated.

1945 Recipient of Appreciation of Services as Consultant to the Secretary of War.

1945 Vice President, International Council of Scientific Unions.

1945 Correspondant, Académie des Sciences de l'Institut de France.

1945 "Plant Life of the Pacific World" published in pocket book edition for the Armed Forces, as well as in a larger size sales edition (Macmillan Company).

1945 Honorary Foreign Member, Edinburgh Botanical Society.

1946 Honorary Foreign Member, Kungl. Svenska Vetenskapsakademien.

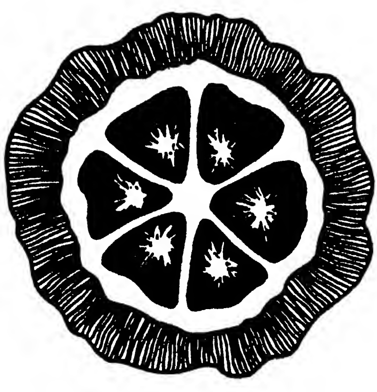
1946 Member, Advisory Scientific Board, Gorgas Memorial Institute.

1946 Member, Board of Directors, Escuela Agrícola Panamericana.

1946 Honorary Fellow, Royal Society of Edinburgh.

1946 "A Botanical Bibliography of the Islands of the Pacific" published.

1946 Resignation as Director of the Arnold Arboretum accepted effective July 31.



*Illustrissimi Auctoris Bibliographia**

— 1899 —

Notes on Maine plants. Rhodora 1: 185-186.

— 1900 —

A criticism on certain new species of Panicum. Bull. Torrey Bot. Club 27: 593-597.

A list of mosses collected at Katahdin Iron Works, Maine. Rhodora 2: 61-63.

The occurrence of Thamnolia in Maine. Rhodora 2: 155.

Agrostological Notes: The grasses in the herbarium of Dr. H. Muhlenberg; Two new species of Eatonia; A new variety of Panicum Nashianum; Nomenclature notes; Notes on Melica and Stipa (with F. L. Scribner). U. S. Dept. Agr. Div. Agrost. Circ. 27: 1-10.

The grasses in Elliott's "Sketch of the Botany of South Carolina and Georgia" (with F. L. Scribner). U. S. Dept. Agr. Div. Agrost. Circ. 29: 1-12. fig. 1-4.

The North American species of Chaetochloa (with F. L. Scribner). U. S. Dept. Agr. Agrost. Bull. 21: 1-44. fig. 1-24.

Notes on Panicum nitidum Lam., Panicum scoparium Lam., and Panicum pubescens Lam. (with F. L. Scribner). U. S. Dept. Agr. Div. Agrost. Bull. 24: 31-38. fig. 8-13.

Some recent collections of Mexican grasses (with F. L. Scribner). U. S. Dept. Agr. Div. Agrost. Bull. 24: 1-30. fig. 1-7.

— 1901 —

Agrostological Notes: Notes on Calamovilfa (with F. L. Scribner); Three new species of Panicum; A new species of Poa (with F. L. Scribner); Some changes in nomenclature. U. S. Dept. Agr. Div. Agrost. Circ. 35: 1-6.

Aristida purpurea Nutt., and its allies. U. S. Dept. Agr. Div. Agrost. Circ. 34: 1-8.

Some Arizona grasses. U. S. Dept. Agr. Div. Agrost. Circ. 32: 1-10.

The New England species of the genus Panicum (with F. L. Scribner). Rhodora 3: 93-129.

— 1902 —

The North American species of Spartina. U. S. Dept. Agr. Bur. Pl. Ind. Bull. 9: 1-16.

Notes on North American grasses. Rhodora 4: 142-147.

Notes on Sporobolus. Rhodora 4: 45-49.

Report by the botanist on an overland trip from Manila to Aparri. Rept. Philippine Comm. Exhibit P. 619-627.

Report of the botanist. Rept. Philippine Comm. Exhibit B. 599-601.

Report of the botanist on the Royal Botanic Gardens of Ceylon and the Botanic Garden at Singapore. Rept. Philippine Comm. Exhibit Q. 627-630.

New or noteworthy North American grasses (with F. L. Scribner). Bull. Torrey Bot. Club 29: 466-470.

— 1903 —

Botanical work in the Philippines. Philip. Isl. Bur. Agric. Bull. 5: 1-53. front.

A dictionary of the plant names of the Philippine Islands. Bur. Sci. Publ. Manila 8: 1-193.

Flora. In: Louisiana Purchase Exposition. Off. Handbook of the Philippines. Part 1: 77-85. 1 pl.

List of Philippine woods. In: Louisiana Purchase Exposition. Off. Handbook of the Philippines. Part 1: 341-357.

Report on investigations made in Java in the year 1902. Philip. Isl. Bur. Forestry Bull. 1: 1-84. pl. 1-10.

Report of the botanist. Rept. Sec. Interior. Exhibit D. 701-713.

— 1904 —

The American element in the Philippine flora. Bur. Sci. Publ. Manila 6: 19-36.

New or noteworthy Philippine plants. Bur. Sci. Publ. Manila 6: 1-18. II. 17: 1-47. pl. 1-3.

— 1905 —

The constituent species of a typical Philippine hill forest. Bur. Sci. Publ. Manila 27: 57-73. (Proof sheets only, withdrawn from publication.)

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* curante cla. Lazella Schwarten.

New or noteworthy Philippine plants, III. Bur. Sci. Publ. Manila 29: 1-50. IV. 35: 1-68.
Notes on Cuming's Philippine plants in the herbarium of the Bureau of Government Laboratories. Bur. Sci. Publ. Manila 35: 69-77.
A review of the identifications of the species described in Blanco's "Flora de Filipinas." Bur. Sci. Publ. Manila 27: 1-132.
Some grasses from Popocatepetl. Contr. U. S. Nat. Herb. 8: 287-290 (list by E. D. MERRILL; introduction by J. N. ROSE).
The source of Manila elemi. Bur. Sci. Publ. Manila 29: 51-55.

— 1906 —

An enumeration of Philippine Gramineae with keys to the genera and species. Philip. Jour. Sci. 1: Suppl. 1: 307-392.
The flora of the Lamao forest reserve. Philip. Jour. Sci. 1: Suppl. 1: 1-141.
New or noteworthy Philippine plants, V. Philip. Jour. Sci. 1: Suppl. 1: 169-246.

— 1907 —

Additional identifications of the species described in Blanco's "Flora de Filipinas." Philip. Jour. Sci. Bot. 2: 429-436.
The ascent of Mount Halcon, Mindoro. Philip. Jour. Sci. Sec. A. 2: 179-203. map.
The flora of Mount Halcon, Mindoro. Philip. Jour. Sci. Bot. 2: 251-309.
Index to Philippine botanical literature. Philip. Jour. Sci. Bot. 2: 241-250. II. 345-349. III. 437-439.
The occurrence of Antiaris in the Philippines. Philip. Jour. Sci. Bot. 2: 111-112.
Some genera and species new to the Philippine flora. Philip. Jour. Sci. Bot. 2: 421-428.

— 1908 —

The genus Radermachera Hassk., in the Philippines. Philip. Jour. Sci. Bot. 3: 331-338.
Index to Philippine botanical literature, IV. Philip. Jour. Sci. Bot. 3: 87-94.
New or noteworthy Philippine plants, VI. Philip. Jour. Sci. Bot. 3: 219-267.
New Philippine plants from the collections of Mary Strong Clemens, I. Philip. Jour. Sci. Bot. 3: 129-165.
The oaks of the Philippines. Philip. Jour. Sci. Bot. 3: 317-330.
On a collection of plants from the Batanes and Babuyanes Islands. Philip. Jour. Sci. Bot. 3: 385-442. map.
Philippine Ericaceae. Philip. Jour. Sci. Bot. 3: 369-382.
Philippine Freycinetia. Philip. Jour. Sci. Bot. 3: 307-315.
The Philippine plants collected by the Wilkes United States Exploring Expedition. Philip. Jour. Sci. Bot. 3: 73-85. pl. 1-4.
The Philippine species of Garcinia. Philip. Jour. Sci. Bot. 3: 359-368.
Notes on Philippine botany (with R. A. ROLFE). Philip. Jour. Sci. Bot. 3: 95-127.

— 1909 —

Index to Philippine botanical literature, V. Philip. Jour. Sci. Bot. 4: 677-685.
The Malayan, Australasian and Polynesian elements in the Philippine flora. Ann. Jard. Bot. Buitenzorg 2: Suppl. III: 277-306.
Medical survey of the town of Taytay. Part V. The principal foods utilized by the natives. Philip. Jour. Sci. B. Med. Sci. 4: 219-223.
New or noteworthy Philippine plants, VII. Philip. Jour. Sci. Bot. 4: 247-330.
A preliminary revision of Philippine Combretaceae. Philip. Jour. Sci. Bot. 4: 641-650.
A revision of Philippine Connaraceae. Philip. Jour. Sci. Bot. 4: 117-128.
A revision of Philippine Loranthaceae. Philip. Jour. Sci. Bot. 4: 129-153.

— 1910 —

Catalogue of the plants cultivated in the city nursery at Cementerio del Norte. Manila. 1-40.
An enumeration of Philippine Leguminosae, with keys to the genera and species. Philip. Jour. Sci. Bot. 5: 1-136.
Index to Philippine botanical literature, VI. Philip. Jour. Sci. Bot. 5: 259-266.
New or noteworthy Philippine plants, VIII. Philip. Jour. Sci. Bot. 5: 167-257.
Prospectus. Plantae insularum Philippinensium. 1-4.
The flora of Mount Pulog (with M. L. MERRITT). Philip. Jour. Sci. Bot. 5: 287-403. pl. 1-4. map.
The grasses of Alaska (with F. L. SCRIBNER). Contr. U. S. Nat. Herb. 13: 47-92. pl. 15, 16.

— 1911 —

The Philippine species of Begonia. Philip. Jour. Sci. Bot. 6: 369-406.

— 1912 —

A descriptive catalogue of the plants cultivated in the city nursery at the Cementerio del Norte. Manila (2nd edition). 1-62. pl. 1-12.

A flora of Manila. Bur. Sci. Publ. Manila 5: 1-490.

Exkursionsflora von Java umfassend die Blütenpflanzen mit besonderer Berücksichtigung der im Hochgebirge wildwachsende Arten (by S. H. Koorders). (Review) Philip. Jour. Sci. Bot. 7: 359-361.

New or noteworthy Philippine plants, IX. Philip. Jour. Sci. Bot. 7: 259-357.

Nomenclatural and systematic notes on the flora of Manila. Philip. Jour. Sci. Bot. 7: 227-251.

Notes on Philippine Euphorbiaceae. Philip. Jour. Sci. Bot. 7: 379-410.

Notes on the flora of Manila with special reference to the introduced element. Philip. Jour. Sci. Bot. 7: 145-208.

On the identity of Evodia triphylla DC. Philip. Jour. Sci. Bot. 7: 373-378.

The Pineda monument and the probable site of the first botanic garden in the Philippines. Philip. Jour. Sci. Bot. 7: 363-369. pl. 22.

Sertulum Bontocense; New or interesting plants collected in Bontoc Subprovince, Luzon, by Father Morice Vanoverbergh. Philip. Jour. Sci. Bot. 7: 71-107.

— 1913 —

The botanical exploration of Amboina by the Bureau of Science, Manila. Science II. 39: 499-502.

Philippine shade trees and ornamental plants, their planting and care. Bureau Public Works Quart. Bull. 2: 34-41.

Plantae Wenzelianae. Philip. Jour. Sci. Bot. 8: 363-390.

Studies on Philippine Melastomataceae, I. Philip. Jour. Sci. Bot. 8: 207-250. II. 335-361. pl. 11, 12.

Studies on Philippine Rubiaceae, I. Philip. Jour. Sci. Bot. 8: 31-63. pl. 1.

— 1914 —

Charles Budd Robinson, Jr. Philip. Jour. Sci. Bot. 9: 191-197.

Dilleniaceae novae. Philip. Jour. Sci. Bot. 9: 517-530.

An enumeration of the plants of Guam. Philip. Jour. Sci. Bot. 9: 17-155.

'Lijst der door Dr. C. B. Robinson in Amboina, op den berg Batoe Gadjah in het Rumphius-Natuurmonument, in Augustus 1914 verzamelde planten. Nederl. Ind. Vereenig. Natuurbescherming Eerste Jaarverslag 1912-13: 135-137.

Meliaceae novae. Philip. Jour. Sci. Bot. 9: 531-541.

New or noteworthy Philippine plants, X. Philip. Jour. Sci. Bot. 9: 261-337.

Notes on Philippine Euphorbiaceae, II. Philip. Jour. Sci. Bot. 9: 461-493.

Plantae Wenzelianae, II. Philip. Jour. Sci. Bot. 9: 353-389.

Sertulum Bontocense; New or interesting plants collected in Bontoc Subprovince, Luzon, by Father Morice Vanoverbergh, II. Philip. Jour. Sci. Bot. 9: 443-459.

— 1915 —

A contribution to the bibliography of the Botany of Borneo. Sarawak Mus. Jour. 2: 99-136.

Genera and species erroneously credited to the Philippine flora. Philip. Jour. Sci. Bot. 10: 171-194.

New or noteworthy Philippine plants, XI. Philip. Jour. Sci. Bot. 10: 1-84. XII. 287-349.

New species of Eugenia. Philip. Jour. Sci. Bot. 10: 207-225.

New species of Schefflera. Philip. Jour. Sci. Bot. 10: 195-205.

On the application of the generic name Nauclea of Linnaeus. Jour. Wash. Acad. Sci. 5: 530-542.

Plantae Wenzelianae, III. Philip. Jour. Sci. Bot. 10: 265-285.

The present status of botanical exploration of the Philippines. Philip. Jour. Sci. Bot. 10: 159-170. map.

A simple method of making carbon leaf impressions. Torreya 15: 175-181. fig. 1-3.

Studies on Philippine Anonaceae, I. Philip. Jour. Sci. Bot. 10: 227-264.

Studies on Philippine Rubiaceae, II. Philip. Jour. Sci. Bot. 10: 99-144.

— 1916 —

Korthalsella, Bifaria, and Pseudixus. Bot. Mag. Tokyo 30: 66-68.

New or interesting Philippine Vitaceae. Philip. Jour. Sci. Bot. 11: 125-145.
New plants from Samar. Philip. Jour. Sci. Bot. 11: 175-206.
New plants from Sorsogon Province, Luzon. Philip. Jour. Sci. Bot. 11: 1-35.
Notes on the flora of Borneo. Philip. Jour. Sci. Bot. 11: 49-100.
On the identity of Blanco's species of Bambusa. Amer. Jour. Bot. 3: 58-64.
On the utility of field labels in herbarium practice. Science II. 44: 664-670.
Osbeck's Dagbok öfwer en Ostindsk Resa. Amer. Jour. Bot. 3: 571-588.
Reliquiae Robinsonianae. Philip. Jour. Sci. Bot. 11: 243-319.
The systematic position of the "rain-tree," Pithecolobium Saman. Jour. Wash. Acad. Sci. 6: 42-48.

— 1917 —

Alabastra Borneensia. Jour. Straits Branch R. As. Soc. 77: 189-247.
Contributions to our knowledge of the flora of Borneo. Jour. Straits Branch R. As. Soc. 76: 75-117.
The dates of publication of the third edition of Blanco's "Flora de Filipinas." Philip. Jour. Sci. Bot. 12: 113-116.
An interpretation of Rumphius's Herbarium Amboinense. Bur. Sci. Publ. Manila 9: 1-595. maps.
Koordersiochloa javanica Merrill, a new genus and species of Gramineae from Java. Philip. Jour. Sci. Bot. 12: 67-71. pl. 1.
New Philippine Lauraceae. Philip. Jour. Sci. Bot. 12: 125-141.
New Philippine Melastomataceae. Philip. Jour. Sci. Bot. 12: 337-360.
New Philippine Myrsinaceae. Philip. Jour. Sci. Bot. 12: 143-158.
New Philippine shrubs and trees. Philip. Jour. Sci. Bot. 12: 263-303.
Notes on the flora of Kwangtung Province, China. Philip. Jour. Sci. Bot. 12: 99-111.
Studies on Philippine Rubiaceae, III. Philip. Jour. Sci. Bot. 12: 159-176.
Two new genera and four new species of Philippine Compositae. Philip. Jour. Sci. Bot. 12: 117-124. pl. 1-3.
Type, cotype, and topotype labels. Torreya 17: 13-15. f. 1-3.
The revegetation of Volcano Island, Luzon, Philippine Islands, since the eruption of Taal Volcano in 1911 (with W. H. Brown and H. S. Yates). Philip. Jour. Sci. Bot. 12: 177-248. pl. 4-16.

— 1918 —

Description of a new species of Pollinia in Java. Bull. Jard. Bot. Buitenzorg III. 1: 16.
New or noteworthy Philippine plants, XIII. Philip. Jour. Sci. Bot. 13: 1-66. XIV. 263-333.
New species of Bornean plants. Philip. Jour. Sci. Bot. 13: 67-122.
Notes on the flora of Loh Fau Mountain, Kwangtung Province, China. Philip. Jour. Sci. Bot. 13: 123-161.
Oreomyrrhis borneensis Merr. sp. nov., an interesting addition to our knowledge of the Malayan flora. Am. Jour. Bot. 5: 514-515. pl. 36.
Species Blancoanae. A critical revision of the Philippine species of plants described by Blanco and by Llanos. Bur. Sci. Publ. Manila 12: 1-423. map.

— 1919 —

Additional notes on the Kwangtung flora. Philip. Jour. Sci. 15: 225-261.
Additions to the flora of Guam. Philip. Jour. Sci. 15: 539-544.
The Bornean species of Eugenia, Schefflera and Saurauia, represented in the Singapore herbarium. Jour. Straits Branch R. As. Soc. 79: 19-35.
New or noteworthy Philippine plants, XV. Philip. Jour. Sci. 14: 365-457.
Notes on the flora of Sumatra. Philip. Jour. Sci. 14: 239-250.
On the application of the generic name Melodorum of Loureiro. Philip. Jour. Sci. 15: 125-137.
On the identity of Polypodium spinulosum Burm. f. Proc. Linn. Soc. N. S. Wales 44: 353-354.
Philippine palms and palm products (with W. H. Brown). Philip. Isl. Bur. Forestry Bull. 18: 1-129. pl. 1-14.
The susceptibility of a non-rutaceous host to citrus canker (with H. A. Lee). Science II. 49: 499-500.
The validity of the name Discomyces for the genus of fungi variously called Actinomyces, Streptothrix, and Nocardia (with H. W. Wade). Philip. Jour. Sci. 14: 55-69.

— 1920 —

Camphorina vs. Cinnamomum. Bot. Gaz. 70: 84-85.

Comments on Cook's theory as to the American origin and prehistoric Polynesian distribution of certain economic plants, especially Hibiscus tiliaceus Linnaeus. Philip. Jour. Sci. 17: 377-384.

Eighteenth annual report of the director of the Bureau of Science, Philippine Islands, for the year ending Dec. 31, 1919. 1-79.

Myrmeconauclea, a new genus of rubiaceous plants from Palawan and Borneo. Philip. Jour. Sci. 17: 375-376.

A new genus of Myrsinaceae from the Philippines. Philip. Jour. Sci. 17: 605-606.

New or noteworthy Philippine plants, XVI. Philip. Jour. Sci. 17: 239-323.

Notes on Philippine Euphorbiaceae, III. Philip. Jour. Sci. 16: 539-579.

On the identity of Aegiphila viburnifolia Jussieu. Philip. Jour. Sci. 16: 449-453. pl. 1.

Studies on Philippine Rubiaceae, IV. Philip. Jour. Sci. 17: 425-485.

— 1921 —

A bibliographic enumeration of Bornean plants. Jour. Straits Branch R. As. Soc. Special Number: 1-637.

New Philippine Moraceae. Philip. Jour. Sci. 18: 49-69.

New Philippine Myrtaceae. Philip. Jour. Sci. 18: 289-308.

A review of the new species of plants proposed by N. L. Burman in his Flora Indica. Philip. Jour. Sci. 19: 329-388.

Two new species of plants from Hainan. Philip. Jour. Sci. 19: 677-679.

— 1922 —

Additions to our knowledge of the Bornean flora. Philip. Jour. Sci. 21: 515-534.

The Bureau of Science and the practical value of its work. National Forum 1: 20-33.

Diagnoses of Hainan plants. Philip. Jour. Sci. 21: 337-355.

New or noteworthy Bornean plants. Part I. Jour. Straits Branch R. As. Soc. 85: 151-201. Part II. 86: 312-342.

New or noteworthy Philippine plants, XVII. Philip. Jour. Sci. 20: 367-476.

Notes on the flora of southeastern China. Philip. Jour. Sci. 21: 491-513.

Twentieth annual report of the Bureau of Science, Philippine Islands, for the year ending Dec. 31, 1921. 1-83. pl. 1-4.

— 1923 —

Correctiones ad Elaeocarpus genus. Fedde Repert. 19: 235.

Diagnoses of Hainan plants, II. Philip. Jour. Sci. 23: 237-268.

Die pflanzengeographische Scheidung von Formosa und den Philippinen. Engl. Bot. Jahrb. 58: 599-604.

Distribution of the Dipterocarpaceae. Origin and relationships of the Philippine flora and causes of the differences between the floras of eastern and western Malaysia. Philip. Jour. Sci. 23: 1-33. pl. 1-8.

An enumeration of Philippine flowering plants. (Bur. Sci. Publ. Manila 18) 1: i-vii. 1-463. 1923-1925; 2: 1-530. 1923; 3: 1-628. 1923; 4: 1-515. pl. 1-6. fig. 1-3. 1926.

New or noteworthy Bornean plants. Part III. Jour. Malay Branch R. As. Soc. 1: 22-45.

Sandoricum Koetjape and Dendrobium caninum. Jour. Bot. 61: 172-174.

Twenty-first annual report of the Bureau of Science, Philippine Islands, for the year ending Dec. 31, 1922. 1-65. pl. 1, 2.

— 1924 —

Bibliography of Polynesian botany. Bull. Bishop Mus. 13: 1-68.

The food problem in Malay Land. Mid-Pacific Mag. 28: 547-554.

New species of plants from Indo-China. Univ. Calif. Publ. Bot. 10: 423-430.

Plants from Banguey Island. Philip. Jour. Sci. 24: 113-116.

Report of the Agricultural Experiment Station of the University of California from July 1, 1923, to June 30, 1924, 1-84.

A consideration of the species Citrus maxima (Burm.) Merrill (with H. A. Lee). Am. Jour. Bot. 11: 382-384. fig. 1, 2.

— 1925 —

Additions to our knowledge of the flora of Hainan. Jour. Arn. Arb. 6: 129-140.

Additions to our knowledge of the Philippine flora, I. Philip. Jour. Sci. 26: 447-496.

An appeal for simplified literature citations. Science II. 62: 419-420.
Explanatory note. Hilgardia 1: i-ii.
Five new species of Chinese plants. Philip. Jour. Sci. 27: 161-166.
New species of Philippine plants collected by A. Loher. Philip. Jour. Sci. 27: 21-59.

— 1926 —

Additions to our knowledge of the Bornean flora, II. Philip. Jour. Sci. 30: 79-87.
Additions to our knowledge of the Philippine flora, II. Philip. Jour. Sci. 29: 475-496. pl. 1. III. 30: 389-430.
Bibliography of Polynesian botany. [Abstract] Proc. Pan-Pacif. Sci. Congr. (Australia) 1923. 1: 329.
The correlation of biological distribution with the geological history of Malaysia. Proc. Pan-Pacif. Sci. Congr. (Australia) 1923. 2: 1148-1155. map.
A discussion and bibliography of Philippine flowering plants. Reprinted from Enum. Philip. Fl. Pl. vol. 4. Philip. Isl. Dept. Agr. Bur. Sci. Pop. Bull. 2: 1-239. pl. 1-6.
An economical herbarium case. Torreya 26: 50-54. fig. 1, 2.
An efficient and economical herbarium paste. Torreya 26: 63-65.
The field label in botanical exploration work. [Abstract] Proc. Pan-Pacif. Sci. Congr. (Australia) 1923. 1: 321-322.
The flora of Banguey Island. Philip. Jour. Sci. 29: 341-429. fig. 1.
Hugh Cuming's letters to Sir William J. Hooker. Philip. Jour. Sci. 30: 153-185. pl. 1.
The influence of the Australian flora on the flora of the Philippines, with an explanation of the anomalous distribution of Australian types in Malaysia. [Abstract] Proc. Pan-Pacif. Sci. Congr. (Australia) 1923. 1: 323-324.
New species of plants from Indo-China, II. Univ. Calif. Publ. Bot. 13: 127-143.
Report of the Agricultural Experiment Station of the University of California from July 1, 1924, to June 30, 1925. 1-78.
Report of the Agricultural Experiment Station of the University of California from July 1, 1925, to June 30, 1926. 1-102.
Sur la synonymie et la distribution du Chloris tenera (Presl) Scribn. Bull. Soc. Bot. France 73: 27-30.
Floristic and faunistic Provinces and Subprovinces of the Philippines (with R. E. Dickerson *et al.*). [Abstract] Proc. Pan-Pacif. Sci. Congr. (Australia) 1923. 1: 330-331.

— 1927 —

An enumeration of Hainan plants. Lingnan Sci. Jour. 5: 1-186.
New Chinese ligneous plants. Jour. Arn. Arb. 8: 3-19.
Report of the Agricultural Experiment Station of the University of California from July 1, 1926, to June 30, 1927. 1-110.
Swinglea, a new generic name in the Rutaceae. Jour. Arn. Arb. 8: 131-132.
Unrecorded plants for Kwangtung Province. Lingnaam Agr. Rev. 4: 119-136.

— 1928 —

The California Botanic Garden. Madroño 1: 163, 164.
A collection of plants from Sarawak. Sarawak Mus. Jour. 3: 513-557.
Flora of the Philippines. Reprinted: Distribution of life in the Philippines. Bur. Sci. Monog. 21: 130-168. pl. 13-22.
The identity of the genus Sarcodum Loureiro. Jour. Bot. 66: 264-265.
Nomenclatural notes on Philippine plants. Philip. Jour. Sci. 35: 1-9.
On the type of Rhus javanica Linnaeus. Jour. Arn. Arb. 9: 1-4. pl. 10, 11.
Some Polynesian botanical problems of fundamental importance. Proc. Third Pan-Pacif. Sci. Congr. Tokyo 1926: 889-893.
Distribution of life in the Philippines (with R. E. Dickerson *et al.*). Bur. Sci. Monogr. 21: 1-322. fig. 1-61. pl. 1-42.
New Philippine plants (with E. Quisumbing). Philip. Jour. Sci. 37: 133-213. pl. 1-4.

— 1929 —

Cooperation with organized agricultural producers. Proc. Forty-second Convent. Assoc. Land-Grant Col. and Univ. 1928: 101-104.
Leprosy bows to science. Rev. of Rev. 80 (478): 79-80.
A new Philippine species of Chloris. Philip. Jour. Sci. 40: 181-182.
Pacific botanical survey. Bull. Bishop Mus. 65: 1-4. 1929.
Plantae Elmerianae Borneenses. Univ. Calif. Publ. Bot. 15: 1-316.

A plea for high standards of instruction in agriculture. Proc. Forty-second Convent. Assoc. Land-Grant Col. and Univ. 1928: 135-141.
Recent research demands on the College of Agriculture. Monthly Bull. Calif. State Dept. Agr. 18: 147-151.
Report of the Agricultural Experiment Station of the University of California from July 1, 1927, to June 30, 1928. 1-127.

— 1930 —

A "big tree" section reaches the Garden. Jour. N. Y. Bot. Gard. 31: 252-253. 1 fig.
Botanical exploration of Borneo. Jour. N. Y. Bot. Gard. 31: 185-191.
Le genre Tolbonia O. Kuntze synonyme de Calotis. Bull. Soc. Bot. France 77: 340-341.
The improbability of pre-Columbian Eurasian-American contacts in the light of the origin and distribution of cultivated plants. Jour. N. Y. Bot. Gard. 31: 209-212.
An international botanical address-book. Science II. 72: 652.
On Miquel's Kwangtung species as based on Krone's collection. Sunyatsenia 1: 1-48. pl. 1-20.
The origin of civilization in relation to the origin of cultivated plants. Jour. N. Y. Bot. Gard. 31: 149.
The Philippine Islands. Jour. N. Y. Bot. Gard. 31: 201-203.
The progress of science. The Fifth International Botanical Congress. Sci. Monthly 31: 565-568. fig. 1.
Report of the Agricultural Experiment Station of the University of California from July 1, 1928, to June 30, 1929. 1-123.
A supplementary list of Hainan plants. Lingnan Sci. Jour. 6: 271-289.
A second supplementary list of Hainan plants. Lingnan Sci. Jour. 6: 323-332.
A third supplementary list of Hainan plants. Lingnan Sci. Jour. 9: 35-44.
Tobacco in New Guinea. Amer. Anthropol. 32: 101-105.
Contributions to our knowledge of the Kwangtung flora (with W. Y. Chun). Sunyatsenia 1: 49-84.

— 1931 —

An appreciation of the Rijks Herbarium. Meded. Rijks Herb. Leiden 65: 1-3.
The local resident's opportunity for productive work in the biological sciences in China. Lingnan Sci. Jour. 7: 293-296.
One name periodicals. Brittonia 1: 1-5.
Photostat service at the New York Botanical Garden. Jour. N. Y. Bot. Gard. 32: 291-292.
The phytogeography of cultivated plants in relation to assumed pre-Columbian Eurasian-American contacts. Amer. Anthropol. 33: 375-382.
A plea for the preparation of a bibliography of the flora of China. Rep. Proc. Fifth Int. Bot. Congr. 528-533.
Report of the Secretary and Director-in-Chief for the year 1930. Bull. N. Y. Bot. Gard. 14: 253-304.
Section of "Big Tree" on exhibit in the Museum of the New York Botanical Garden. Jour. N. Y. Bot. Gard. 32: 240-242. fig. 1.
Unrecorded plants for Kwangtung Province, II. Lingnan Sci. Jour. 7: 297-326.
Urusvati brings America new botanical treasures. Jour. Urusvati Himal. Research Inst. 1: 87-88.
International address book of botanists, being a directory of individuals and Scientfic Institutions, Universities, Societies, etc., in all parts of the world interested in the study of botany (with L. Diels and T. F. Chipp). i-xv. 1-605.

— 1932 —

Coöperation with the Roerich Museum. Jour. N. Y. Bot. Gard. 33: 21-23.
Crops and civilizations. Sci. Monthly 34: 362-365.
The Elizabeth Estes Bigelow memorial. Jour. N. Y. Bot. Gard. 33: 123-125. fig. 1, 2.
Factors to be considered in interpreting Loureiro's species. Jour. N. Y. Bot. Gard. 33: 32-36.
A fourth supplementary list of Hainan plants. Lingnan Sci. Jour. 11: 37-61.
Garden coöperates with G. Proctor Cooper, 3rd, sailing this month on Caribbean survey. Jour. N. Y. Bot. Gard. 33: 237-238.
Index Kewensis in loose-leaf ledger form. Jour. N. Y. Bot. Gard. 33: 268-271. fig. 1.
On the desirability of an actual examination of extant types of Chinese species. Sinensia Spec. Bull. 1: 1-10. 1930. Republished Sinensia 3: 53-62.

Photostat copies of Charles Darwin's letters in Cox collection sent to Down House. Jour. N. Y. Bot. Gard. 33: 14-16.
Report of the Secretary and Director-in-Chief for the year 1931. Bull. N. Y. Bot. Gard. 14: 305-352.
Sixty-pound corm received from Sumatra. Jour. N. Y. Bot. Gard. 33: 155.
The so-called Chinese evergreen — Aglaonema modestum. Jour. N. Y. Bot. Gard. 33: 93-97. fig. 1.
Solanum sanitwongsei. Addisonia 17: 43-44. pl. 566.
New Vitaceae from Fukien, China (with F. P. METCALF). Lingnan Sci. Jour. 11: 101-103.
Begonia Wadei (with E. QUISUMBING). Addisonia 17: 57-58. pl. 573.

— 1933 —

Crops and civilization, cultivated plants and the origins of civilizations. Nat. Hist. 33: 235-250. illus.
Crops and civilizations. Bull. Torrey Bot. Club 60: 323-329.
Eastern Asia as a source of ornamental plants. Jour. N. Y. Bot. Gard. 34: 238-243; republished in Proc. Ninth Nat. Shade Tree Conf. 41-46.
The generic name Parsonsia and the status of Parsonsia helicandra Hooker & Arnott. Brittonia 1: 233-237.
"Jungle Memories" (Review). Jour. N. Y. Bot. Gard. 34: 248-249.
Loureiro and his botanical work. Proc. Am. Philos. Soc. 72: 229-239.
On Poa malabarica Linnaeus. Bull. Torrey Bot. Club 60: 633-638.
Plant forms in ornament. Jour. N. Y. Bot. Gard. 34: 203-205.
State flowers. Jour. N. Y. Bot. Gard. 34: 152-155.
Systematic botany and forestry. Dedication of the Louis Marshal Memorial. February 23, 1933. New York State Coll. Forestry, Syracuse, N. Y. 23-29.

— 1934 —

Annual report of the Director for the year 1933. Jour. N. Y. Bot. Gard. 35: 65-81.
The Elizabeth Gertrude Britton Moss Herbarium is established. Jour. N. Y. Bot. Gard. 35: 210-211.
An enumeration of plants collected in Sumatra by W. N. and C. M. Bangham. Contr. Arn. Arb. 8: 1-178. fig. 1. pl. 1-14.
A fifth supplementary list of Hainan plants. Lingnan Sci. Jour. 13: 53-73.
The gymnosperms of Malaysia, the Philippines, and Polynesia. Proc. Fifth Pacific Sci. Congr. 3267-3271.
Los nombres genéricos Parsonsia y Cuphea. Rev. Sudam. Bot. 1: 97-99.
New Sumatran plants, I. Pap. Mich. Acad. Sci. 19: 149-203. pl. 16-35 (1933).
The problem of economic plants in relation to man in pre-Columbian America. Proc. Fifth Pacific Sci. Congr. 759-767.
The republication of fundamental botanical works of Japan. Jour. N. Y. Bot. Gard. 35: 254-255.
The significance of the compiler's data in field work. Bull. Torrey Bot. Club 61: 71-74.
Some additional Kwangtung plants. Sunyatsenia 1: 189-207. pl. 34.
To the memory of Dr. Bunzo Hayata. Trans. Nat. Hist. Soc. Formosa 24: 389-390.
Unrecorded plants for Kwantung Province, III. Lingnan Sci. Jour. 13: 15-52. pl. 4-8.
Additions to our knowledge of the Hainan flora (with W. Y. CHUN). Sunyatsenia 2: 23-48. pl. 13, 14.
Contributions to our knowledge of the Kwangtung flora (2) (with W. Y. CHUN). Sunyatsenia 2: 3-22. pl. 1-12. fig. 1-3.

— 1935 —

Additions and corrections to Ridley's Flora of the Malay Peninsula. Gard. Bull. Straits Settl. 8: 131-133.
Aglaonema modestum. Addisonia 19: 5-6. pl. 611.
Agricultura y civilización. La Hacienda Año 28: 253-256. illus.
Annual report of the director for the year 1934. Jour. N. Y. Bot. Gard. 36: 77-93.
The Atkins Institution. Harvard Alumni Bull. May 10: 939-941.
Benjamin Lincoln Robinson. Science II. 82: 142-143.
Botany at Harvard University. Sci. Monthly 41: 469-473. illus.
A commentary on Loureiro's "Flora Cochinchinensis." Trans. Am. Philos. Soc. II. 24 (2): 1-445.
The cost of German scientific journals. Science II. 81: 316.

Cystopteris fragilis or C. Filix-fragilis? Am. Fern Jour. 25: 127-131.
International coöperation among botanists. Chron. Bot. 1: 5-6.
Kenneth Kent Mackenzie, 1877-1934. Proc. Linn. Soc. 147: 184-185.
Loureiro e a sua obra botânica. Tradução de P. E. Cavique Santos. Agros. II. 18: 1-15.
Nathaniel Lord Britton. 1859-1934. Proc. Linn. Soc. 147: 161-165.
New Sumatran plants, II. Pap. Mich. Acad. Sci. 20: 95-112 (1934).
Proceedings of the International Botanical Congress. Jour. N. Y. Bot. Gard. 36: 253-254.
A sixth supplementary list of Hainan plants. Lingnan Sci. Jour. 14: 1-62. fig. 1-18.
Some Malaysian phytogeographical problems. Gard. Bull. Straits Settl. 9: 49-57.
Where our food plants came from. Torreya 35: 25-30. 1 pl. Reprinted in Girl Scout Leader 12: 4, 10. illus.
Additions to our knowledge of the Hainan flora, II (with W. Y. Chun). Sunyatsenia 2: 203-332. pl. 36-71. fig. 22-47.
Styrax in the Philippines (with E. Quisumbing). Philip. Jour. Sci. 56: 313-317. pl. 1.

— 1936 —

The Arnold Arboretum during the fiscal year ended June 30, 1936. Jour. Arn. Arb. 17: 357-369.
The identity of Convolvulus reptans Linnaeus. Philip. Jour. Sci. 59: 451-453. pl. 1.
Malaysian phytogeography in relation to the Polynesian flora. In: Goodspeed, T. H. Essays on geobotany in honor of William Albert Setchell. 247-261.
Miscellaneous notes on Philippine botany. Philip. Jour. Sci. 60: 27-35.
A new Philippine species of Cycas. Philip. Jour. Sci. 60: 233-239. pl. 1-4.
On the application of the binomial Amaranthus viridis Linnaeus. Am. Jour. Bot. 23: 609-612. fig. 1.
Otto Kuntze's new genera and new species of Indo-China plants. Brittonia 2: 189-200.
Palisot de Beauvois as an overlooked American botanist. Proc. Am. Philos. Soc. 76: 899-920, portr.
Pavetta in China (Rubiaceae). Lingnan Sci. Jour. 15: 17-18.
Scuttling Atlantis and Mu. Am. Scholar 5: 142-148.
Twenty-five years of systematic botany. 1910-1935. Mem. Brooklyn Bot. Gard. 4: 57-70.
Unrecorded plants for Kwangtung Province, IV. Lingnan Sci. Jour. 15: 415-429.

— 1937 —

America's contribution to the Old World. (Review) Geog. Rev. 27: 153, 154.
Aphanomyrtus Miquel and Pseudoeugenia Scortechini. Blumea Suppl. 1: 107-111.
The Arnold Arboretum during the fiscal year ended June 30, 1937. Jour. Arn. Arb. 18: 349-359.
Botanical Collections, Botanic Garden, Bussey Institution, Arnold Arboretum. (Reports for 1935-36.) Off. Reg. Harvard Univ. 34: 292-297. 303-308.
The Cabot Foundation for Botanical Research. Harvard Alumni Bull. 39: 1018-1021.
The Chinese species described in Meyen's "Observationes botanicae" (Beiträge zur Botanik). Jour. Arn. Arb. 18: 54-77.
Coleus Amboinicus. Addisonia 20: 11-12. pl. 646.
Domesticated plants in relation to the diffusion of culture. In: Early Man 277-284.
The Maria Moors Cabot Foundation for Botanical Research at Harvard University. Sci. Monthly 45: 276-281. 7 figs.
Miscellanea Sinensia. Sunyatsenia 3: 246-262. pl. 32.
Myrtaceae. In: E. Irmscher, Beiträge zur Kenntnis der Flora von Borneo. Mitt. Inst. Allgem. Bot. Hamburg 7: 269.
Nathaniel Lord Britton. (1859-1934). Year Book Am. Philos. Soc. 341-343.
New names in Timonius. Jour. Arn. Arb. 18: 130-132.
On Lactuca indica Linnaeus. Bot. Mag. Tokyo 51: 192-196. pl. 3.
On the significance of certain oriental plant names in relation to introduced species. Proc. Am. Philos. Soc. 78: 111-146.
On the technique of inserting published data in the herbarium. Jour. Arn. Arb. 18: 173-182.
Plants and civilizations. Sci. Monthly 43: 430-439. 1936. Reprinted in Harvard Tercentenary 22-43.

Plants and civilizations. Proc. Roy. Can. Inst. III A 2: 26-29.
Polynesian botanical bibliography 1773-1935. Bull. Bishop Mus. 144: 1-194.
Problems in plant nomenclature. Monthly Bull. Hort. Soc. N. Y. Dec. 1937: 9-10, 14-15.
Razumovia Sprengel versus Centranthera R. Brown. Bull. Torrey Bot. Club 64: 589-598.
Rubiaceae. In: E. Irmscher, Beiträge zur Kenntnis der Flora von Borneo. Mitt. Inst. Allgem. Bot. Hamburg 7: 270-301.
New Kwangtung plants (with F. P. Metcalf). Lingnan Sci. Jour. 16: 71-88. fig. 1-6. 168-180. fig. 7-12.
Systematic notes on Hainan plants including new species, I (with F. P. Metcalf). Lingnan Sci. Jour. 16: 181-197. fig. 1-6. II. 389-407. fig. 1-5.
Reinstatement and revision of Cleistocalyx Blume (including Acicalyptus A. Gray), a valid genus of the Myrtaceae. Jour. Arn. Arb. 18: 322-343. pl. 215.

— 1938 —

The Arnold Arboretum during the fiscal year ended June 30, 1938. Jour. Arn. Arb. 19: 446-460.
Biographical Memoir of Nathaniel Lord Britton. 1859-1934. Nat. Acad. Sci. Bibl. Mem. 19: 147-202. ports.
Botanical Collections, Botanic Garden, Bussey Institution, Maria Moors Cabot Foundation for Botanical Research, Arnold Arboretum. (Reports for 1936-37.) Off. Reg. Harvard Univ. 35: 305-307. 315-321. 330-331.
A critical consideration of Houttuyn's new genera and new species of plants, 1773-1783. Jour. Arn. Arb. 19: 291-375.
Domesticated plants in relation to the diffusion of culture. Bot. Rev. 4: 1-20.
New or noteworthy Indo-Chinese plants. Jour. Arn. Arb. 19: 21-70. 3 figs.
New Sumatran plants, III. Pap. Mich. Acad. Sci. 23: 177-202 (1937).
On Houttuyn's overlooked binomials for native or introduced plants in eastern North America. Rhodora 40: 288-293. pl. 495. Reprinted Contr. Gray Herb. 122: 288-293.
The possibilities of a tropical botanical garden in Florida. In: Douglas, M. S. Dedication Fairchild Trop. Gard. 5-7.
Preliminary report on the storm damage to the Arboretum on September twenty-first. Arnold Arb. Bull. Pop. Inf. IV. 6: 70.
Suganda. An interesting aromatic herb. Herbarist 4: 5-9. 1 pl.
A new species of Boottia from Hainan (with F. P. Metcalf). Lingnan Sci. Jour. 17: 567-570. pl. 24, 25.
The Myrtaceae of China (with L. M. Perry). Jour. Arn. Arb. 19: 191-247.
On the Indo-Chinese species of Syzygium Gaertner (with L. M. Perry). Jour. Arn. Arb. 19: 99-116.
A synopsis of Acmena DC., a valid genus of the Myrtaceae (with L. M. Perry). Jour. Arn. Arb. 19: 1-20.
A bibliography of eastern Asiatic botany (with E. H. Walker). Jamaica Plain, Mass. i-xlii. 1-719. 2 maps.

— 1939 —

Additional notes on Houttuyn's binomials. Jour. Arn. Arb. 20: 264-268.
The Arnold Arboretum during the fiscal year ended June 30, 1939. Jour. Arn. Arb. 20: 446-462.
Botanical Collections, Botanic Garden, Bussey Institution, Arnold Arboretum, Maria Moors Cabot Foundation for Botanical Research. (Reports for 1937-38.) Off. Reg. Harvard Univ. 36: 350-354. 362-369. 380-382.
The genesis and development of the Arnold Arboretum. Hillcrest Gardens. The Thirtieth Summer 9-15.
Index Kewensis in improved loose leaf ledger form. Arn. Arb. Bull. Pop. Inf. IV. 7: 37-40. pl. 6.
A new species of Byttneria from Mangareva. Bishop Mus. Occ. Pap. 14: 313-315. 1 fig.
New Sumatran plants, IV. Pap. Mich. Acad. Sci. 24 (1): 63-92 (1938).
Plants and civilization. Off. Prog. 68th Ann. Spring Flower Show Mass. Hort. Soc. 43, 45, 47.
Recent accessions at the Arnold Arboretum. Harvard Alumni Bull. 41: 1002-1004.

Records of Indo-Chinese plants. Jour. Arn. Arb. 20: 346-355.
Two new species of opposite-leaved Ilex from Borneo. Jour. Arn. Arb. 20: 222-224.
William Henry Brown. Science II. 90: 531-532.
Additional notes on Chinese Myrtaceae (with L. M. PERRY). Jour. Arn. Arb. 20: 102-103.
The Myrtaceous genus Syzygium Gaertner in Borneo (with L. M. PERRY). Mem. Am. Acad. Arts & Sci. 18: 135-202. Reprinted Mem. Gray Herb. Harvard Univ. 4: 135-202.
On certain Malaysian species of Meliosma Blume (with L. M. PERRY). Jour. Arn. Arb. 20: 356-360.
On the Brass collections of Pandanaceae from New Guinea (with L. M. PERRY). Jour. Arn. Arb. 20: 139-186. pl. 1, 2.
Plantae papuanae Archboldianae, I (with L. M. PERRY). Jour. Arn. Arb. 20: 324-345.

— 1940 —

Acacias. Off. Prog. 69th Ann. New Eng. Spring Fl. Show Mass. Hort. Soc. 20-21. 23.
The Arnold Arboretum during the fiscal year ended June 30, 1940. Jour. Arn. Arb. 21: 528-543.
Botanical Collections, Botanic Garden, Bussey Institution, Arnold Arboretum, Maria Moors Cabot Foundation for Botanical Research. (Reports for 1938-39.) Off. Reg. Harvard Univ. 37: 385-389. 398-406. 421-422.
Botanical results of the George Vanderbilt Sumatran expedition, 1939. Plants from Mt. Löser. Not. Nat. 47: 1-9.
Homonoia Loureiro (1790) and Lasiococca Hooker f. (1887). Lingnan Sci. Jour. 19: 187-189.
Maize and its origin. (Review.) Geog. Rev. 30: 172-173.
The ochnaceous genus Capusia H. Lecomte (1926), a synonym of the celastraceous Siphonodon Griffith (1844). Jour. Arn. Arb. 21: 108-109.
The origin and evolution of Mediterranean agriculture. (Review.) Geog. Rev. 30: 688.
Records of Indo-Chinese plants, II. Jour. Arn. Arb. 21: 364-391.
A revised list of Hainan Myrtaceae. Lingnan Sci. Jour. 19: 183-185.
Additions to our knowledge of the Hainan flora, III (with W. Y. CHUN). Sunyatsenia 5: 1-200. pl. 1-28. fig. 1-22.
The old world species of the celastraceous genus Microtropis Wallich (with F. L. FREEMAN). Proc. Am. Acad. Arts & Sci. 73: 271-310. Reprinted Mem. Gray Herb. Harvard Univ. 5: 271-310.
A new Philippine Isoetes (with L. M. PERRY). Am. Fern Jour. 30: 18-20. 2 figs.
Plantae papuanae Archboldianae, II (with L. M. PERRY). Jour. Arn. Arb. 21: 163-200. pl. 1. III. 292-327. fig. 1. IV. 511-527.

— 1941 —

The Arnold Arboretum during the fiscal year ended June 30, 1941. Jour. Arn. Arb. 22: 582-597.
The Atkins Institution of the Arnold Arboretum, Soledad, Cienfuegos, Cuba. Arn. Arb. Bull. Pop. Inf. IV. 8: 65-74. pl. 8-10. 1940. Abridged issue. Parks and Recreation 24: 246-251. 2 figs.
Botanical Collections, Botanic Garden, Bussey Institution, Arnold Arboretum, Maria Moors Cabot Foundation for Botanical Research (Reports for 1939-40). Off. Reg. Harvard Univ. 38: 1-40.
The herb garden at the Harvard Botanic Garden. Herbarist 7: 36. 2 figs.
Man's influence on the vegetation of Polynesia, with special reference to introduced species. Proc. Sixth Pacific Sci. Congr. 4: 629-639.
A new species of Premna from the Philippines. Phytologia 2: 5-6.
A note on the dates of issue of the fascicles comprising Cosson's "Illustrationes florae Atlanticae." 1882-1897. Jour. Arn. Arb. 22: 455-456.
A note on the dates of publication of Wight's "Icones Plantarum Indiae orientalis." Jour. Arn. Arb. 22: 222-224.
A simple change in name. Arnoldia 1: 1-2.
The Upper Burma plants collected by Captain F. Kingdon Ward on the Vernay-Cutting Expedition, 1938-39. Brittonia 4: 20-188. 3 figs.
Observations on the Old World species of Turpinia Ventenat (with L. M. PERRY). Jour. Arn. Arb. 22: 543-555.

Plantae papuanae Archboldianae, V (with L. M. PERRY). Jour. Arn. Arb. 22: 32-59. VI. 253-270. VII. 375-388. VIII. 529-542.

A summary of Kentochrosia Lauterbach and Schumann (with L. M. PERRY). Philip. Jour. Sci. 76: 19-21.

—1942—

American weeds in the Old World tropics. Am. Jour. Bot. 29: Suppl. 14s.

The Arnold Arboretum during the fiscal year ended June 30, 1942. Jour. Arn. Arb. 23: 509-521.

Botanical Collections, Botanic Garden, Bussey Institution, Arnold Arboretum, Maria Moors Cabot Foundation for Botanical Research (Reports for 1940-41). Off. Reg. Harvard Univ. 39: 1-44.

The flora of Fukien Province, China. (Review.) Science II. 96: 232, 233.

The Flora of the Hawaiian Islands and the history of the Pacific Basin. (Review.) Geog. Rev. 32: 171-172.

A generally overlooked Rafinesque paper. Proc. Am. Philos. Soc. 86: 72-90.

Microfilm records of the Linnean Society of London. Science II. 96: 352-353.

Modern facsimile reproduction of rare technical publications. Science II. 96: 180-181.

Las plantas domésticas y sus relaciones con la civilización. Rev. Argentina Agron. 9: 265-283. [Translated by JUDITH RUBENSTEIN].

Razumovia Sprengel versus Centranthera R. Brown again. In: Calcutta Royal Bot. Garden 150th Anniversary volume 53-58.

Records of Indo-Chinese plants, III. Jour. Arn. Arb. 23: 156-197.

Sargentia: a word of explanation. Sargentia 1: iii-iv. 1942.

Some aspects of Rafinesque's botanical work. Am. Jour. Bot. 29: Suppl.: 13s-14s.

Hedyotis Linnaeus versus Oldenlandia Linnaeus and the status of Hedyotis lancea Thunberg in relation to H. consanguinea Hance (with F. P. METCALF). Jour. Arn. Arb. 23: 226-230. 1 pl.

Pandanaceae and Myrtaceae (with L. M. PERRY). In: Smith, A. C. Fijian plant studies II. Sargentia 1: 4-5. 74-78.

Plantae papuanae Archboldianae, IX (with L. M. PERRY). Jour. Arn. Arb. 23: 233-265. 267-297. X. 383-416.

—1943—

The Arnold Arboretum during the fiscal year ended June 30, 1943. Jour. Arn. Arb. 24: 488-497.

An attempt to complete the record. Brittonia 5: 25-32.

Botanical Collections, Botanic Garden, Bussey Institution, Arnold Arboretum, Maria Moors Cabot Foundation for Botanical Research. (Reports for 1941-42.) Off. Reg. Harvard Univ. 40: 1-45.

Botanical Survey of the Alcan Highway. Science II. 97: 574.

Destruction of the Berlin Herbarium. Science II. 98: 490-491.

Emergency food plant manuals. Off. Prog. 72nd Ann. New England Spring Flower Show Mass. Hort. Soc. 32, 33, 35, 37, 38. 1 fig.

Emergency food plants and poisonous plants of the Islands of the Pacific. War Dept. Tech. Man. 10-420: i-v. 1-149. fig. 1-113.

Figments of the imagination. Science II. 97: 41-42.

Foreword to An introduction to historical plant geography, by E. V. WULFF, p. vii-viii.

An index to Rafinesque's published technical names for the cellular cryptogams. Farlowia 1: 245-262.

Microfilm records of the Linnean collections and manuscripts. Science II. 97: 110.

New names for ferns and fern allies proposed by C. S. Rafinesque 1806-1838. Am. Fern Jour. 33: 41-56. 97-105.

Rafinesque's publications from the standpoint of world botany. Proc. Am. Philos. Soc. 87: 110-119.

Report of the Exhibition Committee. 1943 Year Book Mass. Hort. Soc. 52-56.

Some economic aspects of taxonomy. Torreya 43: 50-64.

The vegetation of Malaysia. Far Eastern Quart. 2: 66-76.

The Chinese and Indo-Chinese species of Ormosia (with L. CHEN). Sargentia 3: 77-117.

Plantae papuanae Archboldianae, XI (with L. M. PERRY). Jour. Arn. Arb. 24: 34-59. fig. 1-7. XII. 207-217. XIII. 422-439.

— 1944 —

The Arnold Arboretum during the fiscal year ended June 30, 1944. Jour. Arn. Arb. 25: 488-500.

Botanical Collections, Botanic Garden, Bussey Institution, Arnold Arboretum, Maria Moors Cabot Foundation for Botanical Research (Annual Reports 1942-43). Off. Reg. Harvard Univ. 41: 1-41.

A catalogue of vascular plants [of S. Tomé]. (Review) Science II. 100: 521-522.

Dermatitis caused by various representatives of the Anacardiaceae in tropical countries. Jour. Am. Med. Assoc. 124: 222-224.

Emergency food manuals. Arnoldia 4: 29-36. pl. 3-5.

Foreword to Rafinesque's "A Life of Travels." Chron. Bot. 8: 292-297. pl. 5, 6.

Plants. In: The Pacific World. Edited by F. Osborn. 94-102.

Plantae papuanae Archboldianae, XIV (with L. M. PERRY). Jour. Arn. Arb. 25: 183-205.

— 1945 —

The Arnold Arboretum and its work. Jamaica Plain, Mass. April, 1945. Unpaged folder. (6 p.)

The Arnold Arboretum during fiscal year ended June 30, 1945. Jour. Arn. Arb. 26: 484-498.

Begonia in the Pacific Islands. Begonian 12: 83. 97.

Botanical Collections, Botanic Garden, Bussey Institution, Arnold Arboretum, Maria Moors Cabot Foundation for Botanical Research (Annual Reports 1943-44). Off. Reg. Harvard Univ. 42: 1-37.

Contact poison plants in the Old World tropics. U. S. Army Med. Dept. Bull. 87: 115-117.

Destruction of the Bureau of Science at Manila. Science II. 101: 401.

Emergency food manuals. Chron. Bot. 9: 174-176. 2 pl.

Fern names in Bartram's "Travels," 1791. Am. Fern Jour. 35: 23-25.

Foundations of plant geography. (Review.) Scientific Monthly 60: 76.

In defense of the validity of William Bartram's binomials. Bartonia 23: 10-35.

Men of science in America. (Review) Jour. N. Y. Bot. Gard. 46: 203-204.

Notes on Russian and other European herbaria. Science II. 101: 355.

Ochrocarpos odoratus (Rafinesque) Merrill, a new name for a much named species, with a new species from Samoa. Jour. Arn. Arb. 26: 93-96. 1 fig.

On the underground parts of Tacca pinnatifida J. R. & G. Forst. (1776) = Tacca leontopetaloides (Linn.) O. Kuntze. Jour. Arn. Arb. 26: 85-92. pl. 1, 2.

The Philippines as a source of orchids. Am. Orchid Soc. Bull. 13: 328-334. fig. 4.

The phytogeographic divisions of China, with special reference to the Araliaceae. (Review) Geog. Rev. 35: 691.

Plant life of the Pacific World. i-xv. 1-295. fig. 1-256. Macmillan Company, New York. (Fighting Forces edition, Infantry Journal, Washington, D. C. i-xviii. 1-298. fig. 1-256.

Report of the president. In: Proc. Seventh Annual Meeting Fairchild Trop. Garden, Feb. 21, 1945. 7-9.

[Report on progress "Index Rafinesquianus."] Year Book Am. Philos. Soc. 1944: 172-173.

Reports from recipients of grants from the research funds. Year Book Am. Philos. Soc. 1944: 172-173.

Sir David Prain. (1857-1944). Year Book Am. Philos. Soc. 1944: 379-383.

Two new species from the vicinity of Hongkong. Jour. Arn. Arb. 26: 163-167. fig. 1-3.

Records of monocotyledonous plants new to the flora of Hainan (with F. P. METCALF). Lingnan Sci. Jour. 21: 1-14.

Plantae papuanae Archboldianae, XV (with L. M. PERRY). Jour. Arn. Arb. 26: 1-36. pl. 1. XVI. 229-266. fig. 1-11.

— 1946 —

The Amos Eaton Herbarium. Bartonia 24 (in press).

The Arnold Arboretum, Harvard University, Jamaica Plain, Massachusetts. The Garden Club of America [Programme Annual Meeting May 14, 15, 16]: 23-27. illus.

The Arnold Arboretum, Harvard University, Jamaica Plain, Massachusetts. Bull. Garden Club Am. S 10, 7: 9-13.

Botanical bibliography of the Islands of the Pacific. Contr. U. S. Nat. Herb. 30 (in press).

Botanical Collections, Botanic Garden, Bussey Institution, Arnold Arboretum, Maria Moors Cabot Foundation for Botanical Research (Reports for 1944-1945). Off. Reg. Harvard Univ. (in press).

Dr. Thomas Barbour. Am. Nat. 80: 214-216. portr.

Further notes on tobacco in New Guinea. Amer. Anthropol. 48: 22-30.

A Mindoro fern adventure. Am. Fern Jour. 36: 33-47. 1 fig.

New plant names published by Amos Eaton between the years 1817 and 1840 (with J. R. Reeder). Bartonia 24 (in press).

Plantae Papuanae Archboldianae, XVII (with L. M. Perry). Jour. Arn. Arb. 27: 193-233.

Report of the Committee on exhibitions. Yearbook Mass. Hort. Soc. 1946: 45-49.

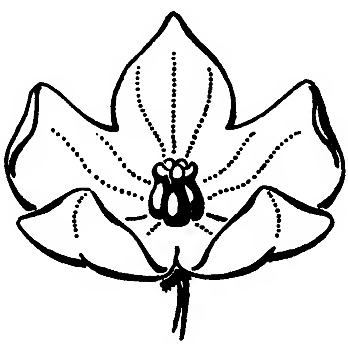
Report of the President. Proc. Eighth Ann. Meet. Fairchild Trop. Gard. 6-8.

Some additional records for the Guam flora (with L. M. Perry). Jour. Arnold Arb. 27: 323-325.

Thomas Barbour (with others). Harvard Univ. Gazette 41: 135.

Thomas Barbour. Jour. Wash. Acad. 36: 283-284.

Unlisted Pteridophyte binomials in Eaton's "Manual of Botany." Am. Fern Jour. 36 (in press).



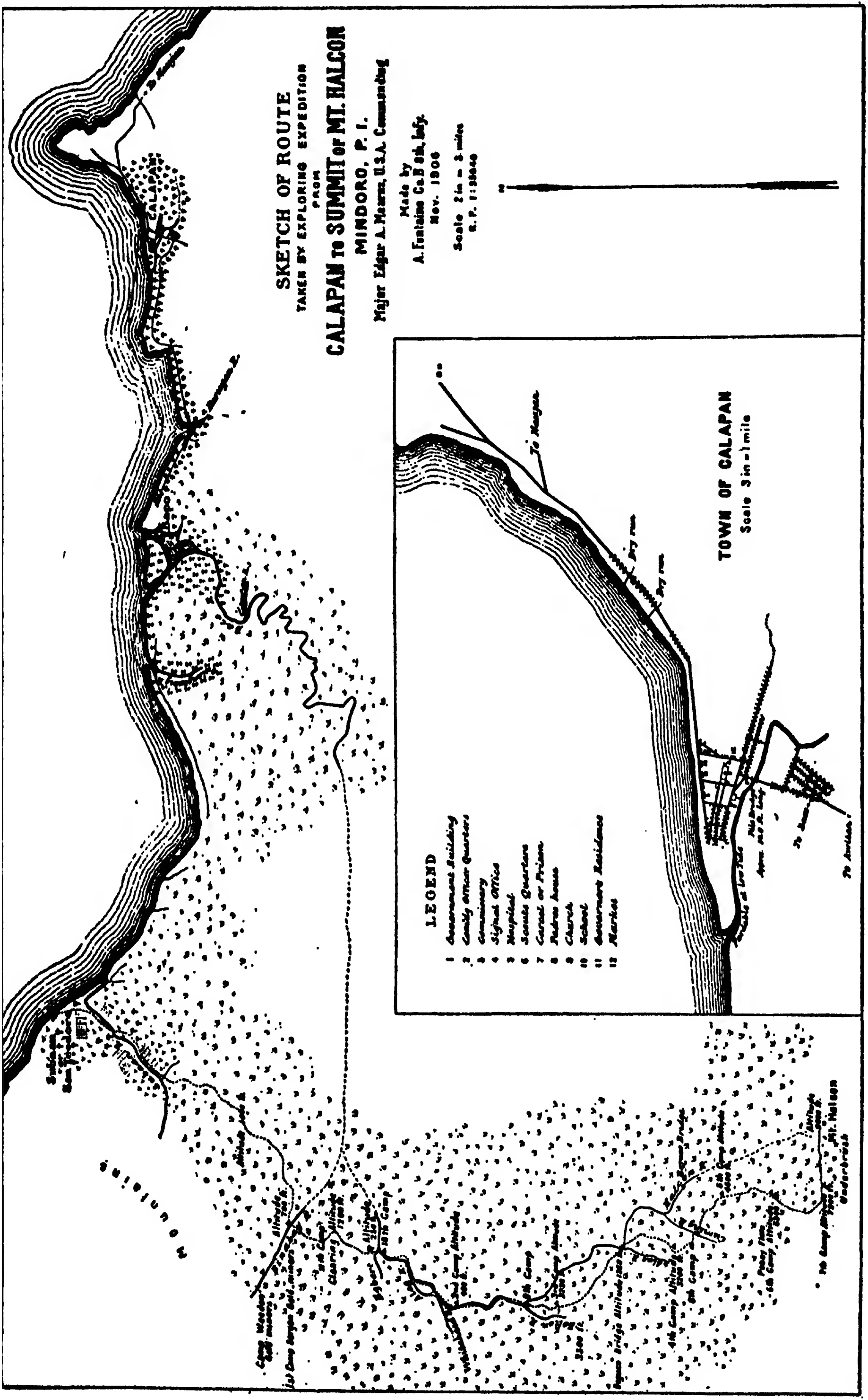

SKETCH OF ROUTE
TAKEN BY EXPLORING EXPEDITION
FROM
CALAPAN TO SUMMIT OF MT. HALCON
MINDORO, P. I.
Major Edgar A. Mearns, U.S.A. Commanding
Made by
A. Fontaine Co. B 8th Infy.
Nov. 1906
Scale 2 in = 3 miles
R. F. 1:95040
TOWN OF CALAPAN
Scale 3 in = 1 mile
LEGEND
1 Government Building
2 Comdg Officer Quarters
3 Commissary
4 Signal Office
5 Hospital
6 Scouts Quarters
7 Cuartel or Prison
8 Padres house
9 Church
10 School
11 Government Residence
12 Market
Mt. Halcon
Mountains

PLATE I.

— I —

THE ASCENT OF MOUNT HALCON*[1]

[179] The Philippine Archipelago is essentially mountainous. Many of the high peaks have been ascended by white men, although accurate accounts as to when, by whom and under what circumstances the explorations were made are to be found in but few instances. On making local inquiries in regard to the ascent of mountains one usually hears vague rumors of previous attempts to climb them, entailing great difficulties, privations and not infrequently loss of life. Usually, however, it is quite impossible to verify many of these rumors for, as a rule, natives living in the vicinity of the mountains have very little information regarding them, and because of prevailing superstitions it frequently is difficult to induce them to accompany a party when the known object of the expedition is to ascend a high mountain.

Mountain climbing in the Tropics, especially in such tropical countries as the Philippines, can scarcely be classed as a sport, and here as in other parts of Malaya, the higher mountains have usually not been ascended by persons for the pure love of mountain climbing, but by those who have had some special object in view, such as the study of the fauna, flora or geology of the region. In other words, the high peaks of the Philippines, as in the Malayan region generally, have been ascended mostly for what was to be secured on them.

Mount Apo in southeastern Mindanao is the highest in the Philippines, yet the first recorded ascent which I have been able to find is that of *J. Montano,* a Frenchman, who reached the summit in October, 1880.[2] Montano, however, states that an attempt was made by the Spaniards in 1852 under the direction of *Oyanguren,* which failed after the loss of twenty men, and that in 1870, *Real,* then the governor of Davao, made another, but unsuccessful endeavor, to reach the summit. Dr. *A. Schadenberg* ascended Apo in February, 1882, and *Otto Koch* must have made the ascent at about the same time for Vidal[3] figures some species [180] of plants from the summit of Apo which were collected by the latter. Since 1880 Mount Apo has been climbed many times by various persons, to my knowledge by at least ten Americans within the past five years, and I am informed by those who have made the ascent that there are comparatively few difficulties to be encountered, either in the approach to the mountain or in its ascent. Nevertheless, as late as 1905 I have seen accounts in Manila newspapers "of the first ascent of Mount Apo."

We have no records that Mount Malindang, the second highest mountain in the Philippines, had been ascended previous to 1906, when in May of that year Maj. *E. A. Mearns* and *W. I. Hutchinson* and their party reached the summit. Mounts Banajao, Pinatubo, Tonglon, Datá, Solis,

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* E. D. MERRILL, "The Ascent of Mount Halcon, Mindoro" (Philippine Journal of Science II, 3, Section A:179-203, 1907).

[1] This is the first of a series of articles on geographical subjects which it is proposed to publish.—P. C. F.

[2] Voyage aux Philippines et en Malasie (1886), 245-264.

[3] Sinopsis, Atlas (1883).

and Mayón, all in Luzon, Canlaon in Negros, Madiaas in Panay, all 7,000 feet in altitude or higher, have been ascended one or many times each, by various persons, and secondary mountains such as Mariveles, Arayat, Maquiling, Isarog and Iriga in Luzon, Silay in Negros, Pulgar and Victoria in Palawan, and many others, are more or less known.

Halcon the third highest peak in the Philippines, is situated in the north-central part of Mindoro. With no known trails leading to it, surrounded by dense forests, cut off from the coast by difficult ridges and large rivers subject to enormous and appalling floods, it stood seemingly inaccessible. Its location is perhaps in the most humid part of the Philippines, where the rains continue for nine months in the year, in a region geographically quite unknown and inhabited by a sparse population of entirely wild and very timid people, and on an island regarding which there is a widespread and generally accepted belief as to its unhealthfulness. Although within 100 miles of Manila and not more than 15 from Calapan, the capital of Mindoro, so far as I have been able to determine it remained unconquered up to the year 1906.

Mindoro

Mindoro ranks as seventh in size among the islands of the Philippine Archipelago, being located a little north of the center of the entire group and having an area of approximately 3,851 square miles. In general outline it is roughly triangular, its greatest length being from northwest to southeast, 110 miles, its greatest breadth from northeast to southwest, 56 miles. Geographically, it is in closer proximity to Luzon than to any other large island of the group.

Verde Island passage, separating Mindoro from the south coast of Batangas Province, Luzon, is but 7½ miles in width in its narrowest part between Escarceo Point, Mindoro, and Malocot Point, Luzon. The small island of Lubang lies 15 miles north of the northwest point, while the larger island of Marinduque is 23 miles east of the central part of Mindoro. Tablas is situated 31 miles east of southern Mindoro, and Panay 36½ miles east of south. Busuanga, the beginning of the Palawan chain, is 33 miles southwest.

[181] The name Mindoro is of Spanish origin, taken from *Mina de oro,* meaning mine of gold, applied by the earlier Spanish explorers. It came no doubt from tales imparted to them by the natives of the fabulous mineral wealth of the island, yet for over three and three-quarters centuries this reputed golden treasure has remained undiscovered. The ancient native name of the island was Mait.

Topographically, Mindoro is exceedingly rough and the interior is very imperfectly understood; it is known locally as "the Africa of the Philippines." The mountains in the north culminate in the Halcon Range, the highest peak being exceeded among Philippine mountains only by Apo and Malindang, both in Mindanao.

The census of the Philippine Islands taken in 1903 gives the total population of Mindoro as 28,361, of which 21,097 are classified as civilized and 7,264 as wild. As comparatively little is known regarding the Mangyans, the aborigines inhabiting the interior, the latter figure must be considered as approximate rather than exact. The civilized inhabitants are confined

entirely to the coast region, the Tagalogs predominating in the north, the Visayans in the south.

Undoubtedly the Negritos are the aboriginal inhabitants of the island and the Mangyans are the descendants of Negrito and Malayan stock. They are confined entirely to the interior of Mindoro, except in the southern part, where one or two towns of semicivilized Mangyans are located on the coast. Capt. R. G. Offley,[4] United States Army, Governor of Mindoro, states that they are non-Christian but not savages by nature or habit, that they will run at sight of a stranger if his coming and intentions have not previously been announced. They are divided into several groups, the chief among which are the Buquit, Bañgon and Batanganes; these roam in bunches or by families, the oldest acting as chief; they are willing workers, but they have no knowledge whatever of agriculture, and the Christian Filipino avails himself of the fact that they do not know the value of money by giving a handful of salt for a banca, while the price of a small working bolo to a Mangyan has been known to be ten years of servitude. The best description of these people which I have seen is that given by Dean C. Worcester,[5] to whose book the reader is referred. In regard to the Mangyans as a whole, Captain Offley's statement is inaccurate in some respects, for the ones we encountered on the north slopes of Halcon have fairly permanent habitations and also possess a decided knowledge of agriculture, although it is of a very primitive kind. We saw but three representatives of these people on the entire trip, an old man, a boy and a girl, but we passed through numerous clearings, some of them several hundreds of acres in extent where there were houses; however, the inhabitants fled at our approach. In one [182] clearing, at an altitude of about 3,000 feet, we found in cultivation: rice, corn, sugar-cane, bananas, yams, sweet potatoes, tomatoes, beans, squashes and taro, while domestic pigs and chickens were in evidence. Most of the dwellings were very small and primitive, consisting of a platform raised two or three feet above the ground, with a thin palm-leaf roof and usually without walls, but in the clearing mentioned above we found an unusually large and well-constructed house about 20 feet long, 15 feet wide and 12 feet from the floor to the apex of the roof. It was firmly constructed, elevated on posts about 6 feet above the ground, with a pole floor and grass-thatched roof and walls and was evidently the abode of a person of prominence in a local tribe. Such a pretentious house certainly is unusual among the Mangyans.

Mindoro has attained and still retains a widespread but apparently not entirely deserved reputation for unhealthfulness, frequently being spoken of as "the white man's grave." In spite of adverse reports as to the unwholesomeness of Mindoro and the prevalence of fevers and various tropical diseases in the island, on our trip, which extended over forty days in the height of the rainy season when on nearly every day all members of the party were wet at least once and sometimes all day and for many days in succession, working our way slowly through drenched forests, fording streams and much of the time on short rations, none of the Americans in the party were sick and among the twenty-five natives employed, only three

[4] Census of the Philippine Islands (1903), **2:** 547.

[5] The Philippine Islands and their People (1901): 375-377; 406-418.

contracted fever and then in a very mild form. In common with previous explorers in Mindoro, we found the leeches very abundant and exceedingly troublesome at the lower altitudes but we became entirely free of them after reaching the height of about 5,000 feet. Ordinary brown soap was found to be an excellent leech repellent and this was given each day to our native carriers who smeared it on their naked legs. Previous experience had taught us that canvas or leather leggings are entirely unsatisfactory as a protection against leeches, and all the Americans in the party were equipped with woolen "puttees." These proved to be more satisfactory and gave absolute protection against the attacks of leeches. Quinine was issued regularly to all members of the party.

Mount Halcon

The name Halcon is of Spanish origin signifying falcon, but the application of this name to the mountain is not clear. As usual, the native names vary. According to Lieut. Fitzhugh Lee's report of his trip made across Mindoro in 1904, the natives living at the mouth of the Baco River knew it as the Alag Mountain. We found those living at Subaan, only 7 miles from Baco, speaking of it as the Baco.

The altitude of the highest peak is given on Spanish charts as 3,865 [183] meters, while our uncorrected aneroid readings determine an altitude of 9,000 feet, both of these records apparently, being too high. In April, 1906, a triangulation party of the Coast and Geodetic Survey, under the direction of Mr. O. W. Ferguson, estimated the height of the mountain as 8,504 feet, the mean of three determinations from as many different stations. The same party ascertained the geographical coördinates of the highest peak to be latitude N. 13° 15′ 46″, longitude E. 120° 59′ 29″.

Viewed from the coast, Halcon appears to present no particular difficulties so far as the ascent is concerned. It is a long, more or less broken ridge running from east to west, presenting steep slopes, especially on the north, but with three pronounced spurs with more gradual slopes leading from it, one to the east, one to the south and one to the west. The crest line of these spurs present rather gradual slopes, although they are steep in places. Several subsidiary spurs lead off from the main range in various directions, notably to the north. Difficulties encountered in making the ascent of Halcon, as is the case with most Philippine mountains, were found to be not so much in the actual climbing as in the approach to the mountain, the fording of streams, the crossing of ridges, the cutting of trails through the dense vegetation and in the transportation of necessary supplies and equipment.

The highest peak of Halcon shows no signs whatever of ever having been visited by human beings, and as it would be a physical impossibility for any person to reach the summit without extensive trail cutting, it seems evident that in recent years at least, it has never been visited by man. Several attempts to reach the top of the mountain have been made and in the past three centuries it is possible, but not probable, that some of the early Spanish explorers in their search for the fabulous mineral wealth of Mindoro, might have made the ascent. I have been able to find no account whatever of attempts made by the Spaniards, and the utter inaccuracy of

Spanish maps as to the location of Halcon Peak and the course of the Alag and Baco rivers would indicate that they had no positive knowledge whatever of this part of Mindoro. In fact, on many maps such a large river as the Alag is not indicated at all, although it joins the Baco at tide water and at less than 3 miles from the coast.

Previous Ascents of the Mountain

In April, 1891, *Dean C. Worcester* visited some Mangyan clearings on the slopes of Mount Halcon, probably ascending to about 2,500 or 3,000 feet. However, so far as I can learn he made no attempt to reach the summit, but his trip in this vicinity is the first one of which I have any knowledge. The reader is referred to his own account of his Mindoro experiences.[6]

[184] In October, 1895, *John Whitehead,* an English naturalist tried to reach the summit, but although he did not succeed in attaining the highest peak he was undoubtedly the first person to reach an altitude of 6,000 feet. As Whitehead's primary object was to collect objects of natural history and especially birds, he apparently made no serious attempt to reach the highest point on the mountain. I can do no better here than to quote from W. R. Ogilvie Grant's[7] account of Whitehead's experience on Mount Halcon.

> On the 19th of October, 1895, he (Whitehead) left Manila with a staff of seven collectors for the Island of Mindoro, with the object of exploring the well-wooded highlands of this comparatively little known island, and returned to Manila on the 16th of February, 1896, after four months' absence. The results of this expedition are, Mr. Whitehead considers, by no means satisfactory, for at the time of his visit the wet season was at its height and, owing to the almost continuous rains, collecting could be carried on only under the greatest difficulties. He tells us that during his stay on Mindoro seventy days out of a hundred were very wet, twenty dull and drizzling, while but ten were comparatively bright and fine; so it can be understood easily that he was unable to do as much as he had hoped.
>
> Unfortunately, he experienced great trouble with his collectors, all of whom suffered at one time or another from fever, and took every opportunity of misbehaving. One man robbed him of his money, while others, left at the foot of the mountain to make a lowland collection, did practically nothing during many weeks, and sold both gun-caps and powder to the natives. He characterizes his Mindoro collection as representing "four months' very hard work and slow starvation."
>
> On landing in Mindoro a guide was engaged as pilot to the high ground, but this worthy led the expedition by a wrong path, and after a long day's march in the usual deluge of rain, Mr. Whitehead found himself on the bank of a fine river surrounded by the most dense and magnificent forest, where he was forced to remain for ten days waiting for porters. It was here that the expedition was nearly wrecked, the river coming down in a tremendous flood with very little warning. The camp had been pitched about 20 feet above the river, which at this part was about 200 yards wide, but in less than twelve hours, fortunately in daylight, the water was running from 2 to 3 feet deep like a mill race through Mr. Whitehead's tent, while his men had to escape in canoes from another house lower down the river, where most of the less portable boxes had been left.
>
> By great exertions all the baggage was saved. "I have," writes Mr. Whitehead, "seen a good deal of Tropics, but I never encountered such deluges, such incessant rains, or such thousands of leeches. The leeches quite crippled two of my men, and

[6] *Loc. cit.*

[7] Grant, W. R. Ogilvie: On the Birds of the Philippine Islands, Part 7. The Highlands of Mindoro. With field notes by John Whitehead. *Ibis:* (1906) VIII, 6, 457.

one of the two caught 'beriberi' so I sent him back to Manila. All the others had fever, but I got off with two mild attacks of dysentery. I was so reduced, from having nothing to eat but tinned foods and rice, that I became quite weak, losing most of my energy at times. In four months I had eaten only five pigeons, two parrots, and some few thrushes, and, with the exception of eggs, there was no other fresh food to be had." Such is life in the highlands of the Philippines.

By making friends with the true aborigines of Mindoro (the Mangyans) the twenty-five porters required to carry the baggage to the mountains were at last [185] obtained, and, after two days' march under continuous heavy rain, Mr. Whitehead and his men camped at an altitude of 4,500 feet on Mount Dulangan, in the main range of Mindoro. This range of mountains is somewhat horseshoe shaped. Mr. Whitehead continues: "To cut a long story short, it rained all November, all December and all January; one deluge began on the 11th of December, and was perhaps second only to that which floated Noah and his great zoölogical collection, for it continued until the 6th of January, 1896. But for all this I was in good health the climate being cool, seldom over 60° F., and some nights only 52° F.; the mountain of the east side is perhaps over 8,000 feet, but the ranges are mostly from 5,000 to 6,000 feet. I was guided by the natives to a part that attained nearly 6,000 feet, but we could not reach the crest of the mountain from this position. The undergrowth is very dense and, without cutting paths, impossible to get through."

In April, 1904, Lieutenant *Fitzhugh Lee, Jr.*, Twelfth United States Cavalry, accompanied by three other officers, Mr. *H. D. McCaskey,* Chief of the Philippine Mining Bureau, ten American soldiers and thirty native carriers, left Camp McGrath, Batangas, Luzon, with the object of crossing northern Mindoro and if possible, of making the ascent of Halcon. They landed at the mouth of the Baco River and on April 3 proceeded up that river to the junction of the Alag, following that stream in boats to the head of navigation, an estimated distance of 5½ miles. The Alag was chosen as the most feasible route because its direction is more westerly and because the natives insisted that its source was somewhere in the vicinity of Alag, the local name of Mount Halcon. On April 4 the boats were abandoned, the river having become very shallow and swift. The expedition then followed a narrow trail along the bank, the carriers being assigned about 80 pounds each. The stream was very tortuous, averaging from 50 to 60 yards in width and the party was compelled to ford five or six times during the morning's march. On April 5 the advance was continued up the bed of the river but the loads for the carriers had to be reduced in weight, progress being exceedingly slow and hard, as the rocks in the river bed bruised the carriers' feet. On this day the distance covered was but 3 miles and on the day following but 3½ miles. On the 7th of April progress was reported to be very difficult and dangerous because of the large bowlders in the stream bed, the swift current and the steep cliffs on both sides, and on this day they went but 2½ miles. Lieutenant Lee continues:

"It seems to be more difficult than we had anticipated to locate Mount Halcon. Our field of vision is very limited, confined as we are in the bottom of a deep cañon with lofty perpendicular walls and a wilderness of vegetation growing out from either side overhead. Just at this time we are particularly anxious to get a bearing on the mountain that we may locate the easiest course for an ascent."

On this day's march several of the party came in contact with some poisonous plant, spoken of as a species of 'poison ivy,"[8] which on the follow-

[8] Probably *Semecarpus perrottetii* March (*Anacardiaceae*).—E. D. M.

ing days caused them much suffering and inconvenience, eruptions [186] breaking out all over their bodies, and the faces of some individuals swelling so that they could see only with difficulty. On April 8 they succeeded only in covering 2½ miles but they were fortunate in securing the services of a Mangyan as a guide. On the following day, finding further progress up the Alag impossible, they retraced their steps a short distance, leaving the cañon of the Alag and following the bed of a small river flowing from the west,[9] making camp in the bed of this stream at an altitude of 1,500 feet. It rained at intervals during the day and all the night and the party gave up hope of ascending Halcon. On April 10 and 11 they crossed the divide at an altitude of 3,230 feet, striking the headwaters of the Bagbaujan River flowing westward, in these two days suffering much from the attacks of leeches and from the constant rain. On the night of April 12 a camp was made in the narrow cañon of the Bagbaujan but, at 8 p. m., because of the heavy rain and the sudden rise in the river, the water coming up about 5 feet in one-half hour, the party were obliged to desert their tents in the darkness and take shelter on a ledge above. The rain continued until 10 p. m. when the river subsided as fast as it had risen. On the following day they went down the river for a distance of 1¾ miles, being obliged to make use of ropes for scaling the cliffs. This method of procedure continued on the morning of the 14th, but later in the day they came out into a more open country and left the river bed. As much of their food had become wet owing to the prolonged rains, the question of rations became a very serious one and caused the members of the party considerable anxiety. However, after the 14th, no grave difficulties were encountered, the party continued on down the Bagbaujan and reached the mouth of the river on April 19, having been seventeen days in crossing Mindoro.

In June, 1906, Lieut. *T. H. Jennings,* Seventh United States Cavalry, accompanied by Mr. *M. L. Merritt* of the Philippine Forestry Bureau, made an attempt to ascend Halcon, but little information regarding their trip and experiences is available other than Mr. Merritt's report, who being ordered to reach Manila on the last of June was obliged to return to Calapan before the highest part of the mountain was reached. The party left Calapan on the morning of June 13, going overland by a trail leading inland, reached the Catuyran River, the south fork of the Baco, on the morning of the succeeding day and proceeded up this for some distance, and then followed a stream known as the Dulangan River which flows from the Halcon Range. Here most of their carriers deserted them, and they were delayed in securing more. Continuing up the Dulangan River on the 16th, they left the bed of the stream on the following day and took one of the ridges, which was followed on the 18th and 19th until they arrived at the place where Whitehead had established his camp in 1895. Up to this point the trail was fair. One June [187] 21, believing that they were on a ridge leading directly up the mountain, they continued up to an altitude of 5,250 feet, the side slopes of the ridge which they were on being described as very steep and extending for 2,000 feet below. Continuing along the ridge for the succeeding days, on June 26 they reached a peak having an altitude of 7,250 feet, but, on the following day in going along the ridge towards the

[9] Apparently the Bolton River. (See map.)

main range, they came to an impassable cañon separating the spur on which they were from the main range, and accordingly plans were made to descend into the deep valley to the west and to follow the ridge beyond. However, Mr. Merritt who was obliged to return to the coast, left the party on the 28th of June and returned to Calapan. Regarding Lieutenant Jennings' experiences after this date we have no information except that he reached Calapan on the 7th of July, having attained the main ridge on Halcon but not the highest peak. Mr. Merritt's report shows that from June 14 to June 27, rainy weather prevailed most of the time.

Previously Lieutenant *Jennings* had made a trip into the interior of Mindoro north of Halcon, following Lieutenant Lee's course up the Baco and Alag Rivers for an estimated distance of 10 miles, where he left the Alag and ascended the ridge to the north, reaching the Binabay River. Mounting the ridge to the north of the Binabay, he followed it for three days, mostly in a westerly direction, finally he recrossed the Binabay River and taking the ridge between it and the Alag River, he continued for five days, going west and somewhat north of west, reaching an altitude of 6,000 feet on a ridge some distance north of Mount Halcon. He reported from his experience on this trip that he did not consider the route from the north a feasible one for the ascent of Halcon, recommending that whoever should make the attempt to climb the mountain, should try a route from the vicinity of Lake Naujan or from the west coast of Mindoro.

Our Own Ascent of Halcon

A geographical and biological expedition to Mount Halcon was planned in October, 1906, under the direction and with the support of Maj. Gen. Leonard Wood, its object being to determine some feasible route to the mountain, to ascend the highest peak, to secure as much data as possible and to collect objects of natural history. The party was under the immediate direction of Dr. *E. A. Mearns,* major and surgeon, United States Army, accompanied by Mr. *W. I. Hutchinson,* of the Philippine Forestry Bureau, and myself, with one topographer, one hospital corps man, a sergeant and five privates of the Twenty-fifth Company of Philippine Scouts, two native assistants for Dr. Mearns, and five native carriers from Antipolo, Luzon. Fifteen additional native carriers were secured at Subaan, Mindoro.

We spent the day after our arrival on the morning of October 31 at Calapan, the capital of Mindoro, in repacking the camp outfit, rations and [188] equipment, and in endeavoring to obtain information regarding Mount Halcon. As we expected, but very little which was definite regarding it could be secured in Calapan. Fortunately, we met an American who had a placer claim on the Binabay River and who had been as far inland as the junction of the Binabay with the Alag. He informed us that a good trail existed from Subaan to the Alag River and although he had no information regarding the country beyond the Alag, he was of the opinion that Halcon could be reached and ascended by this route. Topographically, this seemed to us to be the more direct way, although Lieutenant Jennings had reported his belief that a more feasible route could be found from the south, either by way of the Catuyran River, a tributary of the Baco, from

Lake Naujan, or from the west coast. We were already acquainted with Mr. Whitehead's experiences on the Dulangan spur of Halcon and also aware of the fact that Lieutenant Jennings had been unable to reach the highest peak of Halcon by following Whitehead's course, and as a selection of any of the routes suggested by Lieutenant Jennings would have necessitated much more overland travel than by way of the trail leading inland from Subaan to the Alag River, the latter was chosen. Accordingly, two large native boats were secured to take the party and equipment up the coast to Subaan, a small village about 10 miles northwest of Calapan; November 1 was entirely occupied in making this trip, and in securing the native carriers for the journey inland. On the morning of November 2 the party left Subaan for the Binabay River, two scouts remaining behind to guard the food supply and equipment which was not immediately taken forward. As rations for forty days had been brought and as the equipment and supplies for field work were bulky and difficult to transport, it was found quite impossible to secure the necessary carriers to take all at one trip, so that plans were made to establish camps from time to time and have the material brought in by relays. The trail for about 2 miles led through an open, flat, semicultivated region and shortly after leaving the coast we were obliged to ford the Subaan River, a stream of considerable size. At the end of 2 miles the trail left the level land and crossed a broad, interrupted ridge, densely forested with magnificent trees and broken by ravines containing small streams, some tributary to the Subaan River, others to the Binabay. The highest altitude reached on this ridge was about 1,000 feet. We established our first camp where the trail crossed the Binabay River at a distance of about 6 miles from Subaan and at an altitude of 700 feet, making it with some American miners who had located a placer claim in the stream bed as coarse gold to a limited extent is found in the sand.

On November 3 the carriers were sent back to Subaan for more supplies and the other members of the party reconnoitered for trails in the vicinity leading towards Halcon, climbing to the top of the ridge to the [189] southwest to an altitude of 1,200 feet. At the top of this ridge we entered the first Mangyan clearing and here saw the only representatives of these people who were encountered on the entire trip.

Three small houses, each consisting of a platform raised 2 to 3 feet from the ground, with a thin roof of palm leaves, but without walls, were located in this clearing, and later, along the ridge a short distance to the southwest, a larger house was found. All the houses were deserted on our arrival in the clearing, but on the return trip, in the first house we found an old man and his son, who told us that his family had fled at our approach, but that when he saw there were white men in the party he had returned. These people were all small in size, being about 4 feet 10 inches in height, their hair was short and curly.

From the opening which we had reached we secured a magnificent view of Halcon to the south, while the coast region and Calapan were visible to the east. We found two trails leading down to the Alag River, one from the southeast corner of the clearing and the other from the south side. The latter, being more in the direction of Halcon Peak, was selected for our route. On November 5, our carriers having arrived from Subaan the day before, we left the Binabay River and on arrival in the clearing mentioned

above again encountered the old Mangyan who said that he was too old to act as our guide, but that he could secure for us one who knew the trails. As a guide familiar with the routes leading to Halcon would have greatly facilitated our work, he was asked to procure one, but after waiting about an hour we decided that he had no intention of returning and so we went on to the Alag River. The trail was well defined, leading down a 30° to 45°, well forested slope. Just before we reached the Alag the path crossed a tributary stream of considerable size which offered no difficulties in fording and as none of our natives had a name for it, we christened it the Egbert River in memory of the late General Harry V. Egbert, United States Army. The distance from the Binabay River to the Alag was about 2 miles. At the point where the trail reached the Alag, the stream was about 100 yards wide, not very deep but quite swift and from the place where we first forded the stream to an altitude of 1,200 feet, where we made our last crossing in the ascent, we found no still water whatever. The American miners living on the Binabay informed us that during the previous ten days there had been comparatively little rain and accordingly we found the Alag fordable. An attempt was made to cross it at the junction of the Egbert River, but it was found to be too swift and deep at that point and we were obliged to proceed up the stream for several hundred yards and then to follow an indirect course along the bars in the more shallow water. It was necessary to ford the stream several times during the day's march in order to avoid abrupt bluffs and cliffs. The Alag, at a distance of about 1 mile above the junction of the Egbert, divides into [190] two nearly equal branches; one, flowing from the direction of the Halcon Range was considered to represent the main stream and the other, being unknown to any of our party, was named Whitehead River in honor of the late John Whitehead, an English naturalist who made the first serious attempt to ascend Halcon.

From the entrance of the Egbert River to that of the Whitehead, the Alag flows through a rather wide valley lying between two low, densely forested ridges, the river in this interval being from 50 to 100 yards wide. Our trail followed the margin of the stream, sometimes on one side, sometimes on the other. However, after passing the entrance of the Whitehead River the banks of the stream became very irregular, its bed being much narrower, so that because of the corresponding increasing difficulties in fording it was found advantageous to travel through the underbrush along a bench about 25 feet above the level of the stream. This necessitated slow progress as we were obliged to cut a trail through the dense vegetation. Continuing on up the Alag for a short distance above the junction of the Whitehead River, Camp Number Two was established late in the afternoon. On November 6 and 7 the carriers were sent back to Subaan for further supplies and the remainder of the party reconnoitered up the Alag. The river cañon was found to be very narrow, with perpendicular cliffs sometimes several hundred feet in height and covered with dense vegetation, which often rose abruptly from the bed of the stream. In searching for the most feasible route for our carriers the banks were climbed at intervals, but in no case could a view be secured because of the dense thickets. It was decided that the only practicable course, for the present at least, was along the bed of the stream. The advance was rendered very difficult because of the narrowness of the cañon and the swiftness of the water which

made fording impossible in most places; moreover, we were aware of the fact that the river was subject to sudden and enormous floods and that in case of heavy rains we were almost certain to be cut off from our base of supplies. The tremendous force of the water in times of floods was much in evidence as we traveled upstream; great water-worn bowlders, 6 to 15 feet in diameter, were everywhere encountered and in places large caverns had been cut in the solid cliffs by the action of the water. At a distance of about a mile above Camp Number Two and at an altitude of 900 feet, another smaller river joins the Alag from the east, this we named the Bolton, in memory of the late Lieut. Edward C. Bolton, former Governor of the District of Davao, Mindanao. This was undoubtedly the stream which Lieutenant Lee's party followed in crossing the divide between the Alag and Bagbaujan Rivers in April, 1904. A beautiful cascade about 15 feet in height exists just below the junction of this with the Alag, here the whole volume of the river is forced through a narrow passage between two large bowlders, falling into a pool surrounded by high cliffs.

[191] On November 8, with twenty loaded carriers, we broke camp and proceeded up the stream to the junction of the Bolton River. Here, finding it no longer possible to follow the Alag, it was decided to take the ridge between it and the Bolton which, however, was exceedingly steep and covered with dense forests. No trail was to be found and accordingly one had to be cleared as we advanced. Ascending to an altitude of 2,250 feet, we came into a deserted Mangyan clearing and before us, across the valley of the Alag, was a magnificent panorama of the entire Halcon Range. Progress during this day had been exceedingly slow because of the difficulties encountered in proceeding along the Alag and in ascending the ridge, it being necessary to limit our speed to that of our loaded carriers. Late in the afternoon it was found that we had covered a distance of but approximately 1½ miles. It was then decided to establish Camp Number Three in the Mangyan clearing, with a subsidiary base camp at the junction of the Alag and Bolton Rivers and consequently natives were sent out to locate water and a messenger was despatched on the trail to instruct our scouts to establish a base camp at the place indicated and to build grass houses of sufficient size to accommodate all of our carriers who were to be traveling back and forth bringing supplies. Just before dark our natives reported "no water" and we prepared for a dry camp, when a brisk shower came on which enabled us to catch enough water for our immediate needs on the tent fly and ponchos. Early on the following morning our natives located a small stream tributary to the Bolton River at several hundred feet below our camp.

As many essential supplies remained at Subaan and at various points along the trail, most of the carriers were sent back to the coast, and from November 9 to 11 the country was explored for trails or for a feasible route to the main range of Halcon. At first it was thought that the best one would be by way of the ridge which we were then on, and that by following this we could avoid descending into the cañon of the Alag. Two of the party followed the ridge to the southwest of our camp for some distance, attaining an altitude of 3,500 feet. Although they found that it might be possible to gain the main range by this route, such a course would necessitate a long detour in order to pass the Alag and practically every foot of the distance would be gained only by trail cutting of the most difficult kind

through the dense ridge thickets. In the meantime others of the party reconnoitered in the direction of Halcon Peak, finding a well-defined Mangyan trail leading to the Alag at some distance from our camp. On November 12, some of our carriers having returned the night before, we left the camp in charge of two natives and proceeded with thirteen loaded carriers along the Mangyan trail to the Alag. The slope was very steep, being 60° to 70°, and after descending about 1,000 feet we reached the bottom of the cañon at a point where [192] two streams of equal magnitude joined. Here we found that the Mangyans, in order to be independent of the river in times of flood, had constructed a suspension bridge across the cañon. This was about 75 feet long, made of seven rattan stems so arranged that the lower three strands formed a foot bridge, the upper two serving as hand rails. On both sides of the cañon these rattans were firmly attached to large trees and on the west bank they passed over a huge bowlder in order to give the span sufficient altitude above the water in times of flood.

The west branch was considered to represent the main stream, and the fork flowing from the direction of Halcon Peak was named the Halcon River. The party crossed the Alag, some by means of the suspension bridge, others by fording; the trail was found to continue on up the opposite bank, undoubtedly leading to a recent clearing of considerable magnitude which was plainly to be seen from our Camp Number Three and from which it did not appear feasible to ascend Halcon. Accordingly, we crossed the Halcon River, taking the ridge between it and the Alag, continuing until we reached an altitude of about 3,200 feet, under the impression that we were on the ridge leading to the main range. Late in the afternoon it was discovered that we had still another cañon to cross, and as our carriers were exhausted, we established Camp Number Four in the forest, without water other than the small supply which we had in our canteens and such meager amounts as could be secured from freshly cut rattan stems.

Striking camp at daybreak on the 13th, we proceeded along the ridge for a short distance when we reached a deserted clearing; passing through this we entered a more recent and occupied one which was several hundred acres in area, where one or two deserted houses were found. About one and one-half hours after this we reached the cañon between us and the main ridge, crossing it near its head. The stream in this cañon was called the Cuming River in honor of Hugh Cuming, an Englishman who made extensive collections of plants and animals in the Philippines between the years 1836 and 1840. Breakfast was prepared at this point and at about 10 o'clock we were again on the march, proceeding up the steep eastern bank of the Cuming River, following a rather indistinct Mangyan trail. Near the top of the ridge we entered a deserted clearing containing the ruins of an old house, where the trail seemed to end. From this point a course was taken up the crest of the ridge, which here was rather broad, although it gradually narrowed as we ascended and we soon found ourselves forced to cut our way through exceedingly dense thickets up an 80° slope. After much difficulty we attained the summit of a small spur covered with dense, characteristic, mossy forest. As it was late in the afternoon when the crest line was reached, Camp Number Five was established on the narrow bench in the dense forest, just below the top of the ridge, a small stream being located [193] about one-fourth of a mile distant and 300 feet below. The

distance covered in this day was only about one and one-half miles. On November 14 the carriers were sent back to the base camp on the Alag River for further supplies and on this and the following day trails were opened up on the ridge to an altitude of 7,000 feet, and a point at an altitude of 6,300 feet was selected for Camp Number Six.

Trail cutting became progressively more laborious as we advanced, because of the increasingly stunted character of the vegetation. No particular difficulties were encountered in the first mile, the trail being opened just below the crest of the ridge, but beyond this point further progress was found to be impossible because of a perpendicular landslide which was in our path, making it necessary for us to force our way through the exceedingly dense thickets up a very steep slope to the top of the ridge, the summit of which was attained at an altitude of about 6,650 feet. This ridge was found to slope gradually upward and it varied from 5 to 30 feet in width, in most parts breaking abruptly on both sides in nearly perpendicular slopes. The crest line forest was composed of stunted trees with short, stout trunks and stiff branches, often semiprostrate, and with large spreading roots raised more or less above the ground. Intermixed with the trees was a heavy stand of shrubs and bushes, while an abundance of the very spiny rattans, and nearly as spiny smilax, clambering everywhere through the thickets, rendering trail cutting always a difficult operation and frequently a painful one as well. Everywhere the ground and the trunks and branches of the trees were covered with thick masses of yellow and green moss, filmy ferns, numerous orchids and other epiphytic plants, the ground mat often being one foot or more in thickness, composed of mosses, lichens, ferns and herbaceous plants. A trail was cleared along this ridge to the foot of the sharp slope at an altitude of about 7,000 feet.

We had been favored with exceptionally good weather up to this time, only an occasional shower interfering with our progress, causing no greater inconvenience than a more or less thorough wetting of our persons, which was of minor importance as we were wet nearly every day in fording streams. However, on reaching an altitude of 4,500 feet we entered the region of practically constant fogs and rains which made traveling exceedingly unpleasant because of the wet thickets and heavy drip from the leaves even when it was not raining, as well as because of the reduced temperature, the thermometer rarely registering above 60° F.

We established Camp Number Six on November 17 at an altitude of 6,300 feet at a point previously selected and at a short distance below where our trail ascended to the crest of the ridge. No running water was to be found within a half mile of the camp, but the practically constant rain which prevailed for the thirteen succeeding days rendered the distance from running water of secondary importance. The slopes on the north were very precipitous and in many places entirely denuded [194] of soil and vegetation, where extensive portions of the main ridge had slid into the valley. The land slides, some of them of recent origin, present a bare, rocky face, covered only in places with a scant growth of grass, herbaceous plants and small bushes. We secured a magnificent view of Halcon, which was 1½ miles distant across a deep valley, by cutting out a few trees on the steep slopes below our camp, but the peak was very rarely visible because of the prevailing fog and rain. Occasionally at intervals of cessation in the

severe storm which now came on, the wind would drive the fog away. Judging from these glimpses it became very evident to us that from our present position the only route leading to the latter was by way of the ridge on which we were. On November 18 our carriers came in from Subaan, having made the trip from the coast in three and one-half days. Some were retained for work about the camp, some were sent back to the base camp at the junction of the Baco and Alag Rivers to remain there until further orders, while others were returned to Subaan to bring in food to supply the party on the trip back to the coast. The ones whom we retained at Camp Number Six suffered much from the cold and dampness, as also did the Americans in the party.

Realizing that our food supply was limited and that, because of the present storm, the Alag would be unfordable and accordingly no further supplies could be brought in, it was deemed unwise to remain in camp hoping for a change in weather, hence, on the morning of November 19, Mr. Hutchinson and I proceeded by way of the ridge to an altitude of 7,000 feet where previously we had cleared a trail. We continued it up the steep slope, attaining the main ridge at an altitude of 7,800 feet; the one leading to Halcon Peak running from the east to the west at about right angles to our ridge trail. The montane brush of the upper ridges became reduced to an open heath commencing at the crest line and extending for some distance down the southern slope, the ground cover consisting of tufted grasses, with only occasionally scattered stunted bushes and shrubs, a most grateful change from the dense, mossy ridge thickets through which previously we had been obliged to cut trails. However, these heath lands were limited in extent and so we passed rapidly through them and found the succeeding ridge thickets to be very much more dense than those farther down. Progress through them was literally foot by foot and then only by constant use of bolo. The heavy rain which had set in a few days before, still continued without cessation, adding to our discomfort, the temperature being constantly below 15° C. Owing to the low temperature, the high wind and the continual rain, our position was exceedingly uncomfortable and at times of especially heavy downpours the warmth of our bodies did not suffice to keep the temperature of our wet clothes up to a degree of comfort, the occasional, heavy bursts of cold rain cooling the body to such an [195] extent that, even with the very active and arduous work of trail clearing in the dense thickets, our sufferings from cold were greatly accentuated. At times, as we came to the crest line, the cold wind would add to our discomfort, although much of the time we were fortunately sheltered from it by the dense thickets. Pitcher plants (*Nepenthes*) became very abundant, clambering everywhere in the thickets, so that in cutting our way through the underbrush, at frequent intervals our bolo slashes would upset the equilibrium of from one to a half dozen pitchers, each holding one-half quart or more of water, which would be precipitated upon us. These irregular douches were far more disagreeable than the constant shower bath from the falling rain.

The heath lands on the upper ridges were interrupted by deep ravines, filled with very dense vegetation through which progress was exceedingly slow. Unfortunately for us, these heath lands were very limited in area and we soon came to a dense ridge thicket which we afterwards learned

continued uninterruptedly to the summit of the highest peak. Along this ridge we cleared a narrow trail to an altitude of about 8,300 feet. As it was then late in the afternoon and with the heavy rain still continuing, we returned to camp, arriving just after dark. On November 20 the storm was much more severe than it had been on the preceding days and we were obliged to remain in camp, having little to do other than to listen to the constant drip of the rain and the roar of the streams in the valley below and wondering about the state of the Alag and the safety of our base camp. On the following day the heavy rain continued through the morning, but it slackened at midday, so that we left Camp Number Six at noon and proceeded up to the main ridge, making Camp Number Seven on the open heath at an altitude of 7,900 feet, carrying with us a tent fly and blankets, as well as food for three days. The carriers employed in transporting the material to the high ridge were immediately sent back to Camp Number Six. Light rains continued during the afternoon's march, but toward evening the clouds lifted somewhat, giving us an indistinct view to the south and west. The country south was much more open than that to the north, many of the slopes being grass covered instead of forested, and a number of Mangyan houses were to be seen below 4,000 feet. The entire country toward the south, so far as could be seen, was very rough and mountainous, but the ocean was visible to the southwest; no view to the east and north could be obtained owing to the fogs and clouds. At the point where we pitched our tent a well-defined Mangyan trail crossed the main ridge from north to south, apparently leading up by way of the cañon of the Halcon River or by one of its tributaries, or from one of the Mangyan clearings which we did not visit. As the trail was a much traveled one it seems probable that there is considerable communication between the people living to the north and to the south of Halcon. Evidently, these [196] Mangyans do not possess the usual superstitions regarding mountains which are found among most natives of the Philippines, or at least not to such a degree as to prevent them from ascending the high ridges. Just before dark the heavy storm set in again, continuing all night and throughout the following day. In spite of it, we left camp on the morning of November 22 with the object of reaching the highest point on Halcon. In passing from the point where we stopped trail cutting a few days before, to the summit of the mountain, we encountered the densest thickets seen on the entire trip, and immediately below the peak it took two men three and one-half hours of constant and heavy work with bolos to open a very narrow trail, for a distance of less than one-half a mile. At 1 o'clock in the afternoon of November 22, twenty-one days from the coast, the party reached the highest point on Halcon. The summit being shrouded in clouds, no view was obtained and as all the members of the party where suffering severely from the cold and rain, we stopped only long enough to take aneroid readings and to deposit a record of the trip, which was placed in a sealed bottle and secured to the largest tree on the summit, there being no bowlders available of which to build a cairn. The top of Halcon is a somewhat flattened ridge about one-eighth of a mile long, sloping gradually to the southeast; the peak is covered with a dense growth of stunted trees, none of them more than 10 feet in height, the ground and the trunks, branches and even smaller

branchlets of the trees being thickly covered with from 5 to 15 inches of moss.

No marks of a trail were observed and no signs were seen anywhere in the vicinity of the peak which would indicate that the summit had ever been visited by human beings, and it would be physically impossible for any person to reach it through the dense forest growth without leaving signs of trail cutting. Late in the afternoon the party arrived at Camp Number Seven and spent a most disagreeable night in wet clothes and blankets, as it was impossible to start a fire because of the continuous wind and rain and consequently no warm food could be prepared. On the morning of November 23 we returned to Camp Number Six and during the two following days we were obliged to remain there because of the storm. On the morning of November 26, our carriers who had remained at the base camp at the junction of the Alag and Bolton Rivers, came back reporting the Alag River very high and unfordable, and for that reason the carriers who had been sent to Subaan had been unable to return; moreover, the food supply at the base camp was very low. As we had no further object in remaining at the higher altitudes we broke Camp Number Six on the morning of November 26 with the intention of sleeping that night at the large Mangyan house described on page 161 [182]. As we had but few carriers, every member of the party was obliged to pack a heavy load. The topographer and hospital corps man left Camp Number Six about half an hour before the remainder of the party, but on [197] our arrival at the Mangyan house they were not to be found, having apparently lost the trail, nor did they appear that night.

On the following day, with the Mangyan house as headquarters, search was made on the back trail for the missing men and messengers were sent down to the Alag River to see if they had arrived at the base camp. No trace of them was found on this day and on the 28th the search was continued. In the morning word was received that they had not appeared at the base camp and accordingly a party was detailed to make a more thorough search on the back trail. However, in the afternoon the lost men appeared in the Mangyan clearing. It seems that on coming down the ridge from Camp Number Six they had missed the trail crossing the headwaters of the Cuming River, and had proceeded for some distance down the main ridge leading toward the Halcon before discovering their mistake. Thinking it possible that they could easily reach the Alag at the point where the suspension bridge crossed the cañon, they continued on down the ridge, but were unable to reach the stream because of the steep cliffs. Accordingly, they retraced their steps for some distance and found an old Mangyan trail which they followed for some time, crossing the Halcon by a second suspension bridge and again attempting to reach the Alag and follow it to the junction of the Bolton River, but once more, because of the dense thickets and high cliffs, they were obliged to give up the attempt. Finally, they retraced their steps by the main ridge, located the trail crossing the headwaters of the Cuming River, and arrived at the Mangyan house after having been out nearly three days without other food than a few acorns which they found in the forest. While we were searching for this party on the ridges, they were in the cañons attempting to reach the streams and accordingly did not hear our shouts or shots.

Because of the weak condition of the men who had been lost, no further progress was made until December 1, except to concentrate our supplies and equipment at Camp Number Nine, at the point where the Bolton River joins the Alag. The Alag was still high and unfordable, although the water was about six feet below the point at which it had been a few days before. All members of the party had been on short rations for several days and there seemed to be no immediate prospect of further supplies reaching us from the coast. On the afternoon of November 30 a rude bridge was built across the Alag at Camp Number Nine by felling trees and floating the trunks down stream so that they lodged against bowlders in the bed of the river, the ends of the trunks being lashed in place with rattan and a hand-rail was added. A brisk rain in the night caused the river to rise considerably and one-half of the bridge was carried away, so that we had to replace it on the following morning. On December 1, the first clear day after thirteen days and nights of nearly constant rain, we broke Camp Number Nine and moved [198] all the material across the river, but as we had with us only seven carriers, a temporary camp was established on the opposite bank and the two American soldiers, who were still in a weak condition, were left in charge.

At noon, the remaining members of the party, all heavily loaded, proceeded down the east bank of the Alag. Many difficulties were encountered during the afternoon. In a number of places where bluffs arose abruptly from the stream and which on the up trip we had been able to avoid by fording the river, we were now obliged to climb, fording being entirely out of the question. These frequent detours entailed extensive trail cutting which, with a 50-pound pack, soon became a decidedly painful operation, especially as in order to find a feasible route we had frequently to climb the steep banks or to follow the nearly as steep ravines to a height of two or three hundred feet or more. Camp was made just after dark at the foot of a bluff on the edge of the river. At daybreak on December 2 we proceeded down the stream to a point opposite the entrance of the Egbert River, where Camp Number Ten was established.

All the carriers were immediately sent up the river to bring down more supplies, a scout, who succeeded in crossing the Alag with some difficulty, went into Subaan for additional ones, and one man was sent to the Binabay River for food. Fortunately for us the weather still continued clear and the Alag fell rapidly. On December 3 the carriers were again dispatched up the Alag to bring down the remaining equipment, returning to camp late in the afternoon, the two soldiers accompanying them and at the same time the bearers from Subaan arrived, reporting that they had encountered serious difficulties in crossing the Alag on the trip back to the coast, but that they had finally reached their destination and started back with supplies. On their return, finding that the river was high and that it was impossible to cross, they remained on the north bank of the stream for three days waiting for the waters to subside, and then returned to Subaan. As the carriers came in late in the afternoon it was impossible for us to move camp across the river on that day. A heavy rain came on in the night which caused us considerable anxiety for the reason that if it continued for any length of time, we should be unable to cross the river on the following day

and would be obliged to follow the stream down to tide-water along the south bank.

The rain continued throughout the night and at daybreak we found that the water had risen about six inches, so that the stream was still fordable, although with great difficulty and considerable danger. Heavily loaded carriers with the assistance of one or two men without loads could usually keep their footing, but some of them were carried downstream by the current, wetting some of our equipment. The Americans in the party who attempted to cross without loads, depending entirely on heavy [199] poles for assistance, were invariably carried down by the current and were obliged to swim the last few yards in the very swift water. After many delays and heavy work all the equipment was taken across the river and transported to the top of the ridge between the Alag and Binabay Rivers, where Camp Number Eleven was established. The party made an early start on the morning of December 5 and proceeded by way of the Binabay to Subaan, arriving there about 2 o'clock in the afternoon. We were obliged to remain in Subaan throughout the following day and 4 o'clock on the morning of December 7 embarked for Calapan on a large sailing banca, arriving at noon. On the night of December 9, after forty days, the party returned to Manila, having accomplished the objects of the trip.

General Observations

No data are available regarding the rainfall in Mindoro but judging solely from the vegetation in the southern part of the Island, the rainfall there is much less and the dry season much more prolonged than it is in the North, in the vicinity of Halcon. The presence of this high mountain and its subsidiary ranges causes an enormous precipitation, extending continuously over nine months of the year, from May to January, while the so-called dry months, February, March and April, are not always completely so, as is to be seen from the heavy rain encountered by Lieutenant Lee in April, 1904. During most of the year the mountain is shrouded in fogs and is very rarely entirely free from clouds for any extended period. The fact that the rivers flowing from the Halcon Range, although comparatively short, carry an enormous body of water and that they are subject to great and frequent floods, as both our party and Whitehead learned from experience, would indicate an abnormally heavy rainfall. The vegetation of Halcon, not only that of the higher altitudes, but of the lowlands surrounding the mountain and extending even to the coast at Baco, demonstrates a high and practically uninterrupted humidity throughout the year. Abundant epiphytes, ferns, orchids and other plants and especially the filmy ferns, which are dependent upon a high and constant humidity for their existence and are identical with, or similar to the species on other mountains in the Philippines at altitudes above 3,000 feet, are found in the vicinity of Halcon, sometimes at sea level. In the forests along the rivers at as low an elevation as 250 feet such plants are abundant and many species are represented.

Halcon is covered with and surrounded by the most dense forests excepting where the vegetation has been destroyed by the Mangyans. From the limits of cultivated land along the coast, extending inward and up to an altitude of 3,000 feet, the trees are of large size and would prove to be of

considerable commercial value for timber if the question of transportation were a more simple one. Beginning at an altitude of about [200] 1,200 feet on the ridge between the Alag and Binabay and at about 5 or 6 miles from the nearest Tagalog settlements, one finds traces of the Mangyans in clearings, occupied or deserted. It is the custom of these people to clear a given area by chopping down the trees and brush and after burning it over they plant upland rice, corn, and other crops. Such clearings will be occupied for one or more years until the soil shows signs of exhaustion, until the slopes are denuded by erosion or until the exuberant tropical vegetation becomes too great an obstacle to the primitive agriculturist. He then clears another piece of ground and the deserted one soon reverts to its former forested condition. After a term of years the same land may be cleared again by the same methods. Everywhere on the more gentle slopes from the Binabay River to an altitude of 3,500 feet on Halcon, we observed clearings in all stages, from those freshly cut and not yet burned to those in cultivation, and from those recently deserted to clearings in all stages of reversion to forest. Some of these were very extensive and must have entailed a great amount of labor, for many of the trees felled were 3 feet in diameter, and the only tools possessed by the Mangyans are working bolos and very small, narrow axes.

From a forestry standpoint, practically all the forests in the immediate vicinity of Halcon have been ruined by the above methods of clearing, for it seems evident that the Mangyan selects virgin woods for his work of destruction, doubtless because he has found from experience that the soil is better than in those localities where he has previously cleared and which have reverted.

The floristic conditions[10] of the lower forests indicate high and continuous humidity, shown by the numerous ferns, mosses and epiphytes. As higher altitudes are reached these epiphytes become progressively more abundant, until on the exposed crest-line ridges, beginning at 4,000 feet, the trees are found to be completely covered with a dense mass of mosses and epiphytes, so thick and close that frequently the bark of the tree is not visible. The character of the vegetation entirely changes, the constituent species of the lower forests disappear and others totally different in aspect take their place. Various species of oak and one species of maple are abundant at intermediate altitudes, but on the ridges the vegetation is largely characterized by certain species found in such habitats throughout Malaya. Epiphytic ferns and orchids and other plants become more plentiful and there is a greater diversity in species; mosses are much thicker and more luxuriant, enwrapping even the branches and branchlets of the trees and forming a deep, soft, soil cover, frequently a foot in thickness. Epiphytic shrubs and vines are abundant and give an added character to the vegetation; rhododendrons, huckleberries, raspberries and [201] other plants characteristic of the more temperate regions made their appearance, and the pitcher plant (*Nephenthes*) becomes common, climbing through the thickets. The vegetation again gradually changes above 4,000 feet, the trees and shrubs become more stunted and dwarfed, epiphytes increase in

[10] For an account of the Flora of Mount Halcon see Merrill, *Philippine Journal of Science, C. Botany* (1907), 2, 251.

abundance, peat moss appears in the ground cover and many of the constituent species of trees, shrubs, herbaceous plants, epiphytes, etc., are again quite different from the ones at 4,000 feet. On gaining the high, main ridge, at 7,800 feet, there is a most radical change; the montane brush has become reduced to a mere heath over considerable areas, the ground having a thin cover of grasses with scattered, stunted bushes and shrubs, a curious mixture of north-temperate and Australian types. These heath lands disappear along the ridge towards the high peak and the montane brush is again in evidence, but more stunted and much more dense than on the lower ridges; epiphytic orchids and ferns become reduced to few species and there is a corresponding increase in the abundance and density of the mosses and lichens which everywhere cover the ground and trunks of the brush. Small branches, even no larger than the finger, appear to be 6 inches or more in thickness owing to their dense covering of yellow and green moss. These upper thickets represent the densest vegetation I have ever observed in the Philippines. It was almost impossible to penetrate it even with a liberal use of the bolo.

Conclusion

The origin of most of the mountains in the Philippines is due to volcanic activity, but Halcon is radically distinct from the others in structure. It is a mass of granite, white quartz, schist and marble. Iron pyrites were observed in some localities, while gold in small amounts is found in the sands of the streams flowing from it. Slate was observed by Mr. McCaskey a short distance north of the main range. In general structure, so far as can be determined from descriptions to be obtained, Halcon seems geologically to be the same as Mount Kinabalu, British North Borneo, the highest peak in the Malayan region.

Halcon Range is a fold, the main ridge running in a generally east and west direction, irregular in profile, but continuous for a long distance at high altitudes. So far as could be determined, three great ridges radiate from the main range, one to the west, one to the south and one to the east, while to the north especially, the slopes are very precipitous and show several subsidiary spurs.

Mindoro itself is anomalous in some respects as compared with other islands of the Philippine group, but later when more definite knowledge is secured regarding it and its neighbors, it may be shown that it is really the oldest part of the Archipelago proper. The one large mammal found in the Philippines, *Bubalus mindorensis,* said to be most closely related to a Celebes form, is confined to the Island of Mindoro; certain [202] genera of lowland plants, such as *Antiaris, Chrysophyllum, Ochthocharis,* etc., characteristic of the Malayan region in the west and south, are known in the Philippines only from Mindoro, while the plants from the higher altitudes on Halcon show remarkable affinities with those known from Mount Kinabalu, North Borneo, in many cases they are of specific identity and encountered only in the two localities. At the same time there is a remarkable number of Australian types present in the Halcon flora. From the geological, botanical and zoölogical evidence at hand, indications are found which would seem to point to an early land connection between Mindoro and some great mass to the west and south, but at the same time there is shown a prolonged

separation and apparently a greater age than has been discovered in any other part of the Philippines proper. It is probable that Mindoro, in the various disturbances which have from time to time submerged portions of the Archipelago, has constantly remained above the sea.

Extensive collections of natural history specimens were made on the trip, but most of the material was collected and prepared under the most adverse conditions. A series of papers based on this matter, which will add much to our knowledge of the fauna and flora of the Philippines is planned.

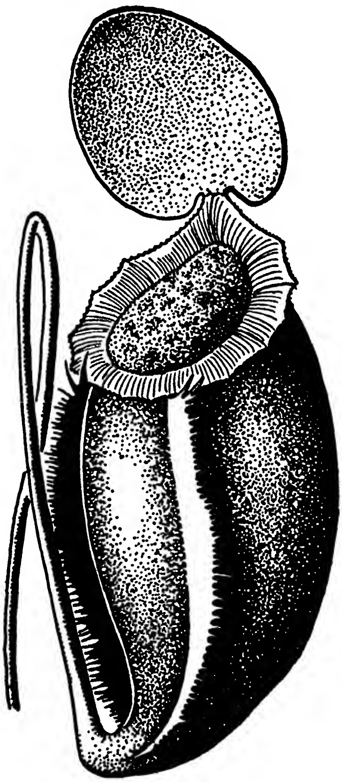
A feasible route to the mountain was discovered and mapped, and it was proved that Halcon could be ascended even at the most unfavorable season of the year. The course of the Alag River was in part determined and charted, this large stream not being shown at all on many maps of the Philippines. Several of its tributaries were located and named.

To anyone contemplating a like trip on Halcon the following recommendations will prove to be of some value, and will apply as well to many other mountains in the Philippines. Brown soap should be issued regularly to the native carriers to be used as a leech repellent. This is smeared on the bare legs once or several times a day if necessary, for the loss of blood from the attacks of leeches is always considerable, and serious complications which might cripple a party in regard to transportation might arise from a resulting infection, for on Halcon the only feasible method of transportation is by carriers. All members of the party wearing shoes should be equipped with woolen puttees instead of leather or canvas leggings, as the former are proof against the attacks of leeches, while the two latter give no protection whatever. Eyeholes on shoes should be smeared with soap each day. Quinine should be issued regularly to the members of the party to guard against outbreaks of malaria. All supplies needed on the entire trip should be carried, as no food can be secured in the interior of Mindoro, at least on the north of the Halcon Range, except a few very poor *camotes,* and some small game such as birds, rats and monkeys, the latter two generally not being considered acceptable food. If one is not limited as to time, doubtless the [203] best carriers for such a trip as we took would be the Mangyans, but they can be approached only with difficulty and because of their superstitions can not be relied upon to stay with a party. As carriers are very difficult to secure in Mindoro and do not prove satisfactory even when they are found, they should be secured at some point in Luzon and landed with the party making the ascent. Camp outfit and equipment should be made as light as possible and food should be confined to essentials. All food supplies and equipment should be wrapped in waterproof packages; the packs should be adapted to carriers and should not exceed 40 or 50 pounds in weight for the ordinary carrier.

The proper time for ascending Halcon, judging from our imperfect knowledge of the rainfall in the vicinity of the mountain, is in the months of February, March, April, and May, but these months are by no means dry, as is shown by Lieutenant Lee's experience north of Halcon in April. During the remaining months of the year heavy rains prevail, and anyone penetrating beyond the Alag River on our route would do so at the constant risk of being cut off from his base of supplies, as in reality happened to our party. To be cut off for any extended period in the interior of Mindoro

would be in most cases a very serious complication and every precaution should be taken to avoid it.

My acknowledgment and thanks are due to Major J. K. Thompson, United States Army, for the accompanying map [CHRON. 10: 158] and for the copies of Lieutenant Lee's report; and to Major George P. Ahern, Director of Forestry of the Philippine Islands, for copies of Lieutenant Jenning's and Foresters Merritt's and Hutchinson's reports.



AMBOINA FLORISTIC PROBLEMS IN RELATION TO THE EARLY WORK OF RUMPHIUS*

[20] The logical and simple plan of exploring Amboina with the special object of collecting and studying the Rumphian species in their native habitat in connection with all data given by Rumphius, while perhaps conceived by other botanists, has previously been carried into effect only by the late Dr. J. G. Boerlage of the botanic garden at Buitenzorg. In 1900 Doctor Boerlage, accompanied by Dr. J. J. Smith, made a trip to Amboina for the explicit purpose of collecting in the classical localities the plants described by Rumphius, more especially material representing those species on which binomials of later authors had been based. Most unfortunately Doctor Boerlage contracted a fever while in Amboina, which resulted in his death at Ternate, August 25, 1900, while returning to Java, with the consequence that the results of his field work were never made available. Unquestionably, many botanists who have visited Amboina and carried on field work there have realized that it was a classical locality in Malayan botany and that botanical specimens from that island would be of special value in interpreting Rumphian species, yet no single large collection has ever been made in Amboina of which the duplicates were given a wide distribution, so that the general results of previous botanical work in Amboina have not been available to many botanists who have had occasion to discuss Rumphian species. While the present consideration of the species described and figured in the Herbarium Amboinense is of necessity incomplete, and doubtless errors in interpretation have been committed both in reference to Rumphian species and to binomials, yet it is felt that the work, somewhat in the nature of an innovation in systematic botany, is a step in advance and that it should prove to be merely preliminary to more intensive field work in relation to the same [21] general problems not only in reference to the Hèrbarium Amboinense, but also to other pre-Linnean works of similar importance.

Certain post-Linnean works are susceptible of the same general treatment, especially those, like Blanco's Flora de Filipinas, in which the various species described are not represented by extant botanical material or types, but must be interpreted solely by the descriptions and data given by the author. In this connection I have in the past four years made an intensive study of all the Philippine species described by Blanco and have prepared for distribution to the larger botanical institutions of the world an extensive *exsiccata* which I have called "Species Blancoanae." The specimens selected for this *exsiccata* are those which I have determined to represent the Blancoan species, and to a large degree these specimens will take the place of Blanco's types, none of which were preserved by him. My Philippine experience in attempting to interpret Blancoan species logically lead

* Excerpts from E. D. MERRILL's, "An Interpretation of Rumphius's Herbarium Amboinense," pp. 21-30 and 38-42 (Publication 9, Bureau of Science, Manila, 1917).

to the application of the same general methods in reference to those figured and described by Rumphius.

In 1902, on commencing botanical work in the Philippines, I was immediately confronted with the problem of interpreting the numerous forms described by Blanco in his Flora de Filipinas,[1] totaling about 1,130 species and varieties, of which not a single one is represented by type material, for Blanco preserved no herbarium specimens. Blanco's species, often very imperfectly described and frequently placed in the wrong genus, have for the most part not been clearly understood by subsequent authors and as a result very many of them appear in botanical literature as doubtful or imperfectly known ones. The average botanist, working in Europe or America from dried specimens alone, with few or no field notes and with no personal knowledge of the Philippines and its vegetation, has found it impossible properly to interpret very many of Blanco's species. The clue to the identity of a Blancoan species is frequently found, not in the description itself, but in the appended economic data, native names, and other information given by Blanco.

My experience in the interpretation of Blanco's species convinced me that the same methods, if applied to Amboina in connection with all the data given by Rumphius in the Herbarium Amboinense, would certainly yield material by which a high percentage of the several hundred species proposed by various [22] authors from 1753 to date might be elucidated. Rumphius's species, like those of Blanco, are not represented by extant botanical material, although it is manifest that Rumphius preserved, at least temporarily, specimens representing some of the forms that he described.[2] Thus, in interpreting Rumphian species, we must utilize the same general methods as those devised in securing material and data to locate Blanco's species. In the interpretation of many Rumphian species the investigator has the great advantage of the published figures, but it should be carefully noted that the figures do not always correspond with the characters of the species indicated in the descriptions [see p. 190 (41)]. In interpreting Blancoan species there is the distinct advantage of his use of technical terms and the rather doubtful advantage of the binomial nomenclature; doubtful not because of the system, but from Blanco's erroneous interpretations of so many genera.

At various times, as it became necessary to interpret species in critical genera by consultation of the Herbarium Amboinense, the necessity of securing botanical material from Amboina became apparent. The desirability of securing Amboina material was discussed by Doctor Robinson and myself at various times during his first tour of duty in the Philippines, 1908-1911. As work on the Philippine flora progressed, the necessity for a definite knowledge of the Rumphian species became more and more evident, until finally the matter was taken up with the Philippine authorities, ap-

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[1] Blanco, M. Flora de Filipinas (1837) LXXVIII + 1-887; ed. 2 (1845) LXIX + 1-619.

[2] Martelli, U. Le collezioni di Giorgio Everardo Rumpf acquistate dal Granduca Cosimo III de'Medici, una volta esistenti nel Museu di Fisica e Storia Naturale di Firenze, estratto da un catalogo manoscritto dal Prof. Giovanni Targioni-Tozzetti (1903) 1-213.

proval of the Amboina project secured, and coöperation with the authorities of the botanic garden at Buitenzorg, Java, arranged.

In preparation for his work in Amboina, Doctor Robinson made an exhaustive examination of the Herbarium Amboinense, and compiled on index cards all data that might be of assistance in his actual field work. He arranged all native names cited by Rumphius, for he realized that the clue to the identity of a Rumphian species would often be found in the native name or names cited. Regions and localities from which Rumphius secured his material were also classified, so that before commencing field work in Amboina, Doctor Robinson could determine to a great extent what species he might hope to find in Amboina and what would have to be sought for in other islands. [23] A special field label was prepared for the work, on which he recorded data of value in connection with the problem of the determination of Rumphian species and the results of his preliminary comparison of the actual specimens with the Rumphian figures and descriptions. This field label is shown in fig. 1.

FLORA OF THE MALAY ARCHIPELAGO

HERBARIUM, BUREAU OF SCIENCE, MANILA, P.I.

Common name ....*Dialect*.......
Field No. .... *Herbarium No.* ....
Collector, C. B. Robinson.
Island ....
Locality ....
Habitat ....
Altitude above the sea ....*m.*
Tree; shrub; woody vine; herbaceous vine; herb ....
Height of plant ....*m.; diameter*................*cm.*
Flower ....
....
Fruit ....
Supposed to represent ....
....
Rumph. Herb. Amb. ....
....

Identification considered certain; probable; possible; very doubtful.

Date.............................., *1913.*

FIG. 1. Form of field label.

His material, as collected, was compared with the Rumphian descriptions, and his conclusions were noted on the field labels. Specimens that were certainly, probably, or possibly identical [24] with forms that Rumphius considered were placed in one series, and those that could not be referred to Rumphian species were placed in another. As material was

matched with forms named and described by Rumphius, such species were checked on a special list. The two series established by Doctor Robinson in the field have been the basis of the two series into which the collections were finally divided for purposes of study. The specimens that could certainly or with a fair degree of certainty be referred to Rumphian species were placed in the series "Plantae Rumphianae Amboinenses," thus cited in the present work, while the remainder were placed in the series "Reliquiae Robinsonianae" and are the basis of a separate report.[3] Of the Plantae Rumphianae Amboinenses, the labels of which bear both the Rumphian name and reference and the binomial as determined by the accepted code of nomenclature, there are about 600 numbers; of the Reliquiae Robinsonianae, including the cellular cryptogams, there are about 960 numbers. In arranging this material and in its critical study, a few specimens have been transferred from one series to the other. In both series collections made at different dates and with separate field numbers have been combined when presenting the same stage of development and unquestionably representing the same form. The data compiled by Doctor Robinson, as a result of his field observations and the comparison of the fresh material with the Rumphian descriptions, has been of immense value in the preparation of the present work.

During the prosecution of his field work in Amboina, it became evident to Doctor Robinson that he could not expect to find all the forms figured and described by Rumphius, nor even all of those that were from Amboina. In his progress report, written from day to day, he frequently mentioned the slow progress of the work and his disappointment in not being able to locate this or that species. He commenced his field work with the idea of taking specimens only from plants found in flower or in fruit, but he occasionally collected single specimens from sterile plants for purpose of check. It is evident that he had located a number of species described by Rumphius of which he collected no botanical material, but which he was watching in the hope that he could later find them in flower or in fruit. At various times he indicated his purpose to collect sterile material of the species that he could not find in flower or in fruit before [25] his final departure from Amboina, a plan that was never carried out on account of his sudden and unexpected death. Many of the very common species, such as the coconut, the betel nut palm, the papaya, and numerous cultivated ornamentals, are lacking in the collection chiefly for the reason that the actual preparation of specimens of these common and well-known plants was purposely deferred until the more important and critical species had been secured.

In the prosecution of his field work in Amboina, Doctor Robinson was handicapped by the same factors that have hindered our attempts to secure material in the Philippines to clear up the status of Blanco's species. With the increase of population in Amboina, as in the Philippines, the original vegetation has been totally destroyed over large areas, the virgin forest being replaced by grasslands, thickets, and second-growth forests of a type entirely different from the original vegetation. Many species definitely

[3] Merrill, E. D. Reliquiae Robinsonianae. *Philip. Journ. Sci.* 11 (1916) *Bot.* 243-319.

mentioned by Rumphius as occurring in specific localities can no longer be found in the indicated places. It is by no means improbable that many species, common in Amboina in the seventeenth century, have now become extinct there, or at least are very rare and local, even as various Philippine species mentioned by Blanco as occurring in definite localities can no longer be found within many miles of the respective places mentioned by him. Native names given by Rumphius have in many cases become obsolete or are so altered as to be hardly recognizable, although in many cases the name cited by Rumphius is still in use and for the same species under which it was cited by him. Rumphius, like Blanco, secured most of his material from the settled areas and from the forests at low altitudes, and it is unfortunately true that, in the Malayan region, the forest vegetation at low altitudes is the vegetation most rapidly destroyed by the encroachment of man.

The practical extermination of the original vegetation of those regions best adapted to agricultural pursuits is a subject that deserves more consideration than it has received.[4] Unquestionably, many species of plants have been exterminated in various parts of the Malayan region within the past century as the population has increased. The areas devoted to agriculture are rapidly being enlarged in many parts of this vast region, and the consequent destruction of primeval forests over large areas is a strong argument in favor of a vigorous and intensive botanical [26] exploration of Malaya, in order that representatives of certain elements of the flora shall be secured while they are still available or at least easily accessible. A continued and intensive exploration of the Moluccas is greatly to be desired before the actual plants that will yield material to clear up various Rumphian species of doubtful status shall have become extinct or at best local and of rare occurrence.

It was originally planned that Doctor Robinson should prosecute his field work for about four months, but as the work progressed it became increasingly evident to him that this period of time was altogether too short. On the basis of representations made by him, Doctor Robinson was authorized to continue his field work until June, 1914, thus giving him practically a year in the field. It was planned that he should also extend his field work to neighboring islands, and at the time of his death he had made arrangements to visit Buru Island, as for the season he had secured a high percentage of the Amboina species to be found in flower or fruit. It was fully realized that his time could be more profitably spent in exploring neighboring islands, utilizing the intermediate periods between trips for a reëxamination of the various parts of Amboina for the purpose of locating in flower or fruit those species that had not been detected during his first period, July to December, of intensive field work. His wholly unexpected death prevented the fulfillment of these plans.

This work has been based on the material and observations secured in a period of four and one-half months. It is evident that could the revised plan have been carried out and field work extended until June, 1914, much more material and data would have been available for study, with the result

[4] Merrill, E. D. Notes on the flora of Manila with special reference to the introduced element. *Philip. Journ. Sci.* 7 (1912) *Bot.* 145-208.

that the interpretation of the Herbarium Amboinense would have been more satisfactory and more nearly complete than it is.

Botanists and collectors who have actually prosecuted field work in Amboina[5] include LaBillardière, the first naturalist to visit the island after Rumphius's death, Christopher Smith, the younger Roxburgh, Lahaie, Reinwardt, d'Urville, Zippel, Lesson, Hombron, Forsten, de Vriese, Teysmann, Naumann, Binnendyk, de Fretes, Beccari, Forbes, Warburg, Karsten, Boerlage, Treub, J. J. Smith, and Robinson. Some were there but for a few days, others for longer periods; and their collections, now widely scattered in different herbaria, comprise several thousand specimens. Were it possible to segregate from the various herbaria [27] all of the Amboina material extant, doubtless many other obscure points regarding Rumphius's species could be elucidated, which in the following critical consideration I have been obliged to interpret from published descriptions alone. Doctor Robinson's four and one-half months of field work in Amboina were insufficient in which to secure the necessary material and data to settle all of the doubtful points in connection with the forms described by Rumphius from Amboina material alone, and he had no opportunity to visit neighboring islands to search for special material that might serve to determine the status of Rumphius's rather numerous extra-Amboina species.

ERRORS IN THE INTERPRETATION OF RUMPHIAN SPECIES

The early botanical authors, such as Linnaeus, Burman f., Loureiro, Lamarck, and numerous others, had but a slight conception of the principles of geographic distribution of plants, and accordingly in their reductions of Rumphius's species many grave errors were committed. Very often in the early literature one finds the illustrations of an Amboina plant quoted as an exact synonym of a species of Indo-China, when in reality the two are totally different and not infrequently have been found to represent different genera. It is not at all certain that in quoting illustrations of various species as synonyms Linnaeus and his contemporaries and immediate successors intended them as exact synonyms; it would seem, in many cases at least, that the citations of illustrations as synonyms was intended to convey to other botantists some conception of what the species was like, and not necessarily to indicate that it was an exact equivalent of the species under which it was cited.

In the first two or three decades following the death of Linnaeus systematists were conservative in the matter of describing new species. There was a very strong tendency to refer specimens to species already named by Linnaeus, rather than to describe material, even from distant and relatively unknown parts of the world, as new. Thus we find Loureiro in his Flora Cochinchinensis, published in 1790, erroneously referring numerous Cochin-China specimens to Linnean species and likewise attempting to match his Cochin-China material with the Amboina species described and figured by Rumphius, apparently on the assumption that if a plant grew in Cochin-China, it should also grow in Amboina. In Loureiro's work there are scores

[5] Warburg, O. Die botanische Erforschung der Molukken seit Rumpf's Zeiten. Rumphius Gedenkboek 1702-1902 (1902) 63-78.

of cases where the Rumphian name and figure are quoted as an exact synonym of a Cochin-China species described by him as new. [28] In very many cases Loureiro took his specific name from Rumphius, yet in not a single case is a species described by Loureiro to be interpreted by the reference to Rumphius, as his descriptions were not based on data supplied by the Herbarium Amboinense, but on actual specimens from Cochin-China or southern China.

We find the same condition in Burman f., Flora Indica (1768), where Burman's conception of the species proposed was not gained from the Rumphian synonym cited, often the only one given, so much as from actual specimens from Java or from some other part of the Indo-Malayan region; in few cases are Burman's species, as published in his Flora Indica, to be typified by the Rumphian reference cited. In the early volumes of Lamarck's Encyclopédie we find likewise numerous cases where species actually described from specimens originating in the Mascarene Islands, in the Philippines, and in other regions remote from Amboina are supplied with a Rumphian synonym, which usually has proved to be misplaced. Error after error has crept into systematic botany by interpretation of species by a Rumphian synonym, wrongly placed, rather than by consultation of the actual type specimen. These errors, once published, have been perpetuated by other authors, sometimes because of failure to interpret types properly, sometimes because of lack of interest in problems of nomenclature, sometimes because of non-accessibility of type specimens for purposes of comparison, and for other reasons. By way of illustration I need cite only one or two extreme cases.

The type of *Fagara triphylla* Lam. is a Philippine specimen collected by Sonnerat, and a recent examination of it in Lamarck's herbarium at the Museum d'histoire Naturelle, Paris, shows it to be identical with the endemic Philippine *Melicope luzonensis* Engl. De Candolle, however, apparently interpreting *Fagara triphylla* Lam. chiefly from the Rumphian synonym, *Ampacus angustifolius* Rumph., cited by Lamarck in the original description, transferred it to *Evodia* as *Evodia triphylla* DC.; and later authors, also interpreting it from the Rumphian synonym, have given *Evodia triphylla* (Lam.) DC. a range extending from India to Japan southward through Malaya to New Guinea. In clearing up this question of synonymy[6] I have shown that *Fagara triphylla* Lam. = *Evodia triphylla* DC. = *Melicope triphylla* Merr. is a species confined to the Philippines; that *Evodia tri-*[29]*phylla* of various authors includes at least three distinct species in two different genera; and now the occurrence of true *Ampacus angustifolius* Rumph. in the Amboina collection shows that this Rumphian species, while a true *Evodia,* represents still another distinct species. *Evodia triphylla* DC. as interpreted by various authors has included at least four distinct species in two different genera.

Another case is that presented by *Ricinus mappa* Linn., based wholly on *Folium mappae* Rumph. This is the basis of *Macaranga mappa* Muell.-Arg., Mueller extending the range of the species to the Philippines by the erroneous reduction of *Croton grandifolius* Blanco as a synonym. I have

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[6] On the identity of Evodia triphylla DC. *Philip. Journ. Sci.* 7 (1912) *Bot.* 373-378.

shown that *Macaranga grandifolia* (Blanco) Merr. is a species entirely distinct from *Macaranga mappa* Muell.-Arg., yet Pax and K. Hoffman[7] in their recent monograph of this group interpret *Macaranga mappa* (Linn.) Muell.-Arg. wholly from Philippine specimens, erroneously citing *Croton grandifolius* Blanco, *Macaranga porteana* André, and *Macaranga grandifolia* Merr. as synonyms, and even figuring the species from Philippine material. A casual comparison of Philippine material with Rumphius's figure, the type of *Ricinus mappa* Linn. = *Macaranga mappa* Muell.-Arg., shows that two totally different species are involved. The occurrence of typical *Folium mappae* Rumph. in Robinson's Amboina collections shows conclusively that I was correct in separating the Philippine form, that Mueller was wrong in reducing *Ricinus grandifolius* Blanco to *Macaranga mappa*, and that Pax and K. Hoffman were entirely wrong in their interpretation of *Macaranga mappa* Muell.-Arg. The two species involved are so entirely different that they belong in distinct sections of the genus.

THE INTERPRETATION OF RUMPHIAN SPECIES AS TYPES

In the interpretation of the species of older authors under which Rumphian names are cited as synonyms one point must constantly be kept in mind. This is, as to whether the species was based on an actual specimen in the hands of the author or, by citation, wholly on the Rumphian description and figure. In nearly every case it is possible to determine this point merely by an examination of the description, for even when no specimen is actually cited, if the species was based on an actual specimen, data are usually given that could not have been derived from [30] either Rumphius's description or figure. Even in Linnaeus's works descriptions based on actual specimens rather than on cited synonyms are usually thus determinable. I have already noted that none of Loureiro's species, even when the specific name is taken from Rumphius, are to be interpreted by the Rumphian synonym cited. The same is true of most of Burman's species published in his Flora Indica, many of those proposed by Lamarck, and those of many other authors. Where a species was based on an actual specimen supplemented by a reference to Rumphius, the specimen is manifestly the type, but it then becomes necessary to determine whether or not the specimen represents the same species as the Rumphian synonym cited. In a very high percentage of such cases the actual specimen described has been found to represent a species different from the one figured by Rumphius, due to the fact that the early authors, having little conception of the geographic distribution of plants, failed to distinguish between the indigenous and endemic elements in the Amboina flora and those species of wide distribution. Among all of the earlier workers there was a strong tendency to refer the Rumphian illustrations to species described from actual specimens, even if there was only a superficial resemblance between the specimen and the figure. None of them realized the necessity of interpreting Moluccan species from Moluccan specimens; and, even if the value of such procedure were realized, no botanical material from Amboina was available to European botanists until the close of the eighteenth century and, even then, only a limited amount.

[7] Euphorbiaceae-Acalypheae-Mercurialinae. Engl. Pflanzenreich 63 (1914) 320.

In the present consideration of the Herbarium Amboinense those species and their synonyms that were based solely on plants described and figured, or merely described, by Rumphius have been indicated by the term "type!" in parentheses following the citation. The list of such species could doubtless have been extended if in the course of the preparation of the manuscript, I had had access to all the literature. As it is, nearly 350 such "types" have been indicated. From the standpoint of taxonomy then, the Herbarium Amboinense is of relatively very great importance, for its descriptions and figures typify a very large number of binomials of later authors. Only two other pre-Linnean works on the Indo-Malayan flora can be compared with the Herbarium Amboinense in this respect, these being Rheede's Hortus Malabaricus and Linnaeus's Flora Zeylanica, and most of the actual specimens on which the later work was based are extant. . . .

THE PRESENT STATUS OF RUMPHIAN SPECIES

[38] Rumphius named and described approximately 1,700 plants that he considered to represent distinct forms. However, many of the plants he named and characterized are "forms" or "varieties" rather than "species" in the generally accepted sense of these words. Slight variations in the color of the leaves, of the flowers, or of the stems of plants; equally slight differences in the size of certain parts; and other trivial characters were deemed by him to be of sufficient importance to warrant the characterization of the form and the bestowal of a distinctive name. Thus, in the case of cultivated plants, such as the coconut, the betel-nut palm, the sago palm, the sugar cane, taro, rice, and balsam, both slight and prominent variants were distinguished, while in wild plants equivalent distinctions were often made.

In terms of the binomial system, as species are understood today, the 1,700 forms named and to a greater or less degree characterized by Rumphius can be reduced to about 1,200 species, including those that, while apparently distinct, are of more or less doubtful status and have not been definitely referred to any genus. Of these 1,200 species about 930 can be definitely or fairly definitely referred to binomials, and about 140 additional ones can be safely placed in their respective genera, leaving about 130 that from data and material at present available cannot be definitely located under the binomial system; some of these cannot be even placed in their proper families. A high percentage of these doubtful species are those that are very imperfectly and briefly described, some being scarcely more than casually mentioned; few of them are figured.

As already noted, many binomials have been based wholly on the Rumphian figures and descriptions. In about 800 cases references to the Herbarium Amboinense are found in the original descriptions or publications of species, while about 350 binomials have been based wholly on various species more or less imperfectly characterized by Rumphius. During the past one hundred and thirty-five years numerous botanists have attempted with greater or less success to interpret these Rumphian species by connecting the Rumphian names and descriptions with actual botanical specimens. Many errors in interpretation and in identification have been made, but the general results have been such that today a high percentage

of the Rumphian species have been definitely connected with extant botanical material, and their true status has been determined. As a result of Doctor Robinson's [39] work in Amboina, the list of doubtful species has been greatly reduced.

In the present consideration about 930 of the Rumphian species have been definitely referred to binomials, and of these about 470 are definitely represented by botanical specimens collected by Doctor Robinson. It should be borne in mind, however, that many of the species that are not represented by specimens collected by Doctor Robinson were originally described by Rumphius from material that did not originate in Amboina, much of it coming from distant lands....

DIFFICULTIES IN THE PROPER INTERPRETATION OF RUMPHIAN SPECIES

[40] The difficulties involved in attempting to interpret the species described by such an author as Rumphius in terms of the binomial system are very great. The actual working up of the Amboina collection has involved two entirely different sets of identifications: first an identification with the form Rumphius described or described and figured; and, second, a further identification of the same specimen to its proper genus and species under the binomial system. Neither task has been an easy one, for very obvious reasons.

In dealing with the Rumphian descriptions, many difficulties are encountered. While often very long, the descriptions are nontechnical, and measurements are largely approximate or comparative. The parts of the flowers are not described in detail, and often they are not even mentioned. The plants described in a single chapter under a "generic" term may belong to a single genus, as the term is understood to-day, or may belong in entirely different genera in distinct or even unrelated families. Many forms are only casually described, sometimes scarcely more than mentioned, while of others the description is reduced to a general description of the wood only. Very many of these casually described species were not based on Amboina material, but on specimens transmitted to Rumphius from various parts of Asia and Malaya. To a certain degree we have succeeded definitely in placing a high percentage of the species that are amply described and figured and a fair percentage of those that are but casually mentioned, but much remains to be done on this subject.

Another factor that has rendered identifications difficult or uncertain is the figures themselves. While many of them are excellent and can be unmistakably referred to their proper species in the binomial system from an examination of the figures alone, others are very crude; some are imperfect in that they delineate only leaf specimens; some are manifestly based on material originating from entirely distinct species or even from representatives [41] of different genera and families, and some do not agree at all with the descriptions to which they are ascribed. As already noted the artist has frequently depicted the leaves on one scale and the attached inflorescences, flowers, or fruits, as the case may be, on an entirely different scale. Very frequently the leaves are reduced in size, while the other parts may be greatly enlarged. In consulting the Herbarium Amboinense, it should be borne in mind that Rumphius himself never saw the

figures which were drawn by various artists after he became blind.

Rumphius's idea of the species was not at all that of the species as understood to-day, nor can his chapter heads be considered as corresponding to the modern conception of the genus. As noted by Doctor Robinson in one of his letters to me:

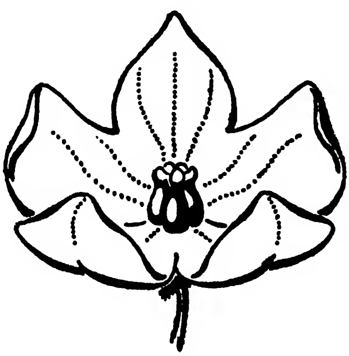
> Rumphius imbibed the native ideas on the relationships of plants, and did his best to improve on them. Now the natives here to-day, and I think certainly also in his time, base their opinions largely on habit and leaf characters, or perhaps on habitat; thus *mangi-mangi* covers the whole mangrove family (*Rhizophoraceae*) with *Sonneratia* thrown in. Also to the characters utilized by the natives in making identifications should be added wood characters, latex if any, taste and smell of leaves, flowers, and fruit. Neither he nor they appreciate the primary value of flowers or fruit or of compound leaves. Again the methods of distinguishing species that we use were entirely unknown to him, as they are to the natives here to-day. We are so accustomed to putting emphasis on simple versus compound and opposite versus alternate leaves; superior versus inferior ovary; and apetalous, polypetalous, and gamopetalous flowers and the number of their parts, that it is difficult to follow a man who took no count of any of these characters, except as to the compound leaves, while his opposite leaves are often opposite leaflets. He says in one place that a menispermaceous plant "maxime convenit" with what proves to be *Derris uliginosa* of the *Leguminosae;* what then about some of the other plants he described that "maxime convenit," when there is no illustration to suggest the identity of the species involved? Take the case of *Ternstroemia, Ichthyoctonos montana* of Rumphius. It is most excellently described and the illustration is fair, yet in this chapter he describes three forms which differ in the color of the wood and of the roots. It is incredible that in an island of this size that there can be three species of this small and characteristic genus to each of which the description can correspond so far as it goes and yet be worthy of being interpreted as three distinct species of *Ternstroemia.* There are two possible conclusions regarding it, and many other similar cases, first, that there is really only one species of *Ternstroemia* and that the differences are merely superficial; and, second, that he had in mind three really different species, not unlikely in as many different families of plants, but that the detailed description applies to one only; the other two forms briefly mentioned in this chapter are inextricable with certainty. Even if a sufficiently perfect knowledge of all the plants found in Amboina did enable us correctly to guess what was intended by the second and third forms of *Ichthyoctonos,* there is nothing in Rumphius's statements by [42] which the correctness of the interpretation could be checked. Again *Macucrus* is divided into "mas" and "femina;" one is a *Cyrtandra,* of the *Gesneriaceae,* and the other is a *Pellionia,* of the *Urticaceae;* but he almost certainly included in the latter an equally common *Elatostema.* *Conocephalus,* of the *Moraceae,* and *Medinilla,* of the *Melastomataceae,* are placed together. It will take much critical work certainly to distinguish in the Herbarium Amboinense such dissimilar plants as *Pipturus,* of the *Urticaceae, Zizyphus,* of the *Rhamnaceae,* other melastomataceous plants including some species of *Medinilla, Celtis,* of the *Ulmaceae,* and even *Strychnos,* of the *Loganiaceae.*

Very many similar cases could be added, but the above statement clearly indicates one particular phase of the difficulties involved in the interpretation of Rumphian species.

The difficulties involved in identifying material under the binomial system have been very real. The herbarium of the Bureau of Science contains only such material as could be accumulated by actual field work and by exchanges in the past fifteen years, and while it contains a very fine series of Philippine species and much valuable material from the Indo-Malayan region generally, many species that I should like to have seen are lacking. Identifications, other than of those species already familiar to me, have been largely made by comparisons with the published descriptions, and very many

such descriptions are entirely inadequate, especially those of the early authors. Whenever possible the original descriptions have been examined, but a number of works that it has been desirable or essential to examine in the course of the preparation of this manuscript are not available in Manila. In very numerous cases resource has been had to transcriptions or photographic reproductions of essential descriptions, and such data have been supplied by various botanists in Europe and America. In one form or another I have thus been able to examine nearly all of the references to Rumphius cited in this work.

In the present consideration of the Rumphian species I have departed radically from the works of previous authors. In order to make the work more generally available to botanists, the Rumphian species, so far as they can be reduced at present, are cited as synonyms under the various species and genera to which they refer, these again being arranged by families and genera in the sequence of Engler and Prantl's Natürliche Pflanzenfamilien. Appended to this systematic treatment of the Rumphian species is a list under the Rumphian names arranged in the sequence of the Herbarium Amboinense, giving references to the volume, the page, and the figure under each and, so far as determinable, their binomial equivalents.



— III —

COMMENTS ON COOK'S THEORY AS TO THE AMERICAN ORIGIN AND PREHISTORIC POLYNESIAN DISTRIBUTION OF CERTAIN ECONOMIC PLANTS, ESPECIALLY HIBISCUS TILIACEUS LINNAEUS*

[377] Mr. O. F. Cook, of the United States Department of Agriculture, has given considerable attention to the theory of the American origin and the prehistoric distribution across Polynesia of various economic plant species, and has published several papers on the subject. In this series of papers there is considerable evidence that their author is inclined to draw conclusions from insufficient data, involving a lack of personal knowledge of the several species as they occur in nature in various parts of the world, especially in the Old World. It would seem also that, accepting the theory of American origin for a particular species, he is prone to discuss the data in support of that theory, subordinating or overlooking facts that are contrary to the general thesis. The result is that the arguments as presented and the conclusions derived therefrom are not always conclusive, and are certainly not always convincing from either a botanical or a philological standpoint.

He has attempted to prove the American origin of the coconut (*Cocos nucifera* Linn.), and its transmission by the Polynesians across Polynesia to Malaya and tropical Asia in prehistoric times,[1] but more convincing to me are the arguments of Dr. O. Beccari[2] that it is a native of Polynesia or tropical Asia, and that it is a halophilous plant, which may have been disseminated in part by ocean currents.

Beccari, among other criticisms of Cook's arguments, has shown that the palm does occur wild in nature, as witnessed by its unaided development on the isolated and uninhabited Palmyra [378] Islands, and that it can compete successfully with the arborescent vegetation of tropical strand floras. He has called attention to the fallacy of the statement that Cook makes regarding the plant as seldom growing on the immediate strand, a statement certainly made without sufficient knowledge of the species as it grows in nature; for, as Beccari indicates, the immediate strand is the habitat par excellence for this palm in the vast Indo-Malayan-Polynesian region, as is witnessed by tens of thousands of miles of palm-lined shores in the Philippines and in the Tropics of the Old World as a whole. Again in support of his general thesis that the coconut was not disseminated by ocean currents,

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* E. D. Merrill, "Comments on Cook's Theory as to the American Origin and prehistoric Polynesian Distribution of certain economic Plants, especially Hibiscus tiliaceus Linnaeus" (Philippine Journal of Science 17:377-384, 1920).

[1] The origin and distribution of the cocoa palm, Contr. U. S. Nat. Herb. 7 (1901) 257-293; History of the coconut palm in America, Contr. U. S. Nat. Herb. 14 (1910) 271-342.

[2] Beccari, O. The origin and dispersal of Cocos nucifera, Philip. Journ. Sci. 12 (1917) Bot. 27-43.

Cook illogically argues that the chances are hundreds to one that coconuts falling into the water will be thrown back immediately upon their own coast like other objects floating in the surf, and further that: "High waves or tides, instead of floating shore débris away, merely carry it farther inland, as everybody familiar with seacoasts knows." If this be always true, as Beccari notes, we should have to evolve some other theory to explain the geographic distribution of the characteristic elements of the strand floras of the world. The revegetation of Krakatao, so far as its present strand flora is concerned, is in direct opposition to the idea that shore débris is *always* carried farther inland by the waves as Cook infers.

Messrs. O. F. and R. C. Cook[8] have recently made the claim that *Hibiscus tiliaceus* Linn. appears to have been distributed over the islands and shores of the Pacific and Indian Oceans before the arrival of Europeans —a claim that no botanist familiar with the geographic distribution of this characteristic species will dispute. When, however, they infer that the primitive Polynesians were in possession of this species before they became acquainted with similar Asiatic plants; that it may have been carried by them from America across the tropical regions of the Old World; and that, therefore, it is one of the economic plants to be taken into consideration in studying the problem of contacts between the inhabitants of tropical America and Polynesia in prehistoric times, it would seem advisable to present the data in opposition to this argument.

With their first contention, "The maho [*Hibiscus tiliaceus* Linn.] * * * appears to have attained a trans-Pacific distribution in prehistoric times," no fault can be found, as the species is one having a true, and certainly natural, pantropic [379] distribution. We later read: "As with the coconut palm and the sweet potato, the *maho* figures more prominently among the Polynesians than among the natives of tropical America, although the American origin of the plant is *even more clearly indicated*" [italics mine]. The paragraph headings "A wild plant in America" and "A cultivated plant in the Old World" emphasize the fact that the authors are unacquainted with the plant as it occurs in the Old World. All botanists familiar with this common species as it occurs in the vast Indo-Malayan region will at once realize that the last paragraph heading is exceedingly misleading.

They concede that the plant is wild and of wide distribution in tropical America, a region with which they are familiar, where it grows naturally along the seashore; but they make the most curious general claim that it is a cultivated plant in the Tropics of the Old World, a region they have apparently never visited. They admit that in some Polynesian islands it grows spontaneously and covers large areas that have been abandoned after previous cultivation, and that low banks of tidal rivers are its favorite habitat. They do not, however, accept the statements made by numerous botanists, many of whom were familiar with the plant in its native habitat in the Old World, that it is a pantropic strand plant. Their theory regarding *Hibiscus tiliaceus* is apparently based largely on the fact that they know the species from personal observation to be a native strand plant in tropical America, plus the statement in various published works that it is cultivated

[8] Cook, O. F., and Cook, R. C., The maho, or mahagua, as a trans-Pacific plant, Journ. Wash. Acad. Sci. 8 (1918) 153-170.

in Polynesia, and the assumption that it is also cultivated in other parts of the Old World Tropics. This being so, they could then reason its transmission by man from the New to the Old World, and interpret various data in support of that hypothesis.

As a matter of fact, outside of Polynesia the species is never cultivated in the Tropics of the Old World, although one occasionally finds individual trees planted inland for ornamental purposes, while on the islands of the Pacific its cultivation is by no means universal; for here, as elsewhere, it is of wide natural distribution along the seashore, and on many islands (Guam for example) it occurs in enormous quantities forming gregarious thickets near the sea. In tropical Asia and Malaya the plant is not of sufficiently great economic importance to warrant its cultivation, and in these vast regions it is certainly not a species that has purposely been disseminated by man, in either prehistoric or historic times. On some Pacific islands it occurs [380] gregariously inland, where it sometimes almost exclusively occupies considerable areas, as I have personally observed in Hawaii. The reasons for its cultivation on some Polynesian islands were undoubtedly that it was the best, or one of the best, of the few fiber plants available to the primitive Polynesians, and that the number of plants growing naturally along the strand was not sufficient to supply the demands for fibers for all purposes. *Hibiscus tiliaceus* was never domesticated or even semi-domesticated in tropical America and in the Indo-Malayan region, for the reason that plants producing better fibers were available in both regions.

I maintain on purely botanical evidence that *Hibiscus tiliaceus* is a species of natural pantropic distribution; that it grows in practically all tropical countries along the seashore, its natural habitat; and that it has been disseminated in ages past by ocean currents. Its seeds are beautifully adapted to dissemination by floating for, although small, they are provided with a smooth impervious testa, and float for many months without sinking. In fact, no one has as yet recorded his ability to cause them to sink naturally, investigators being satisfied from experimentation with the statement that they "float for months."

Even in Polynesia it is exceedingly doubtful if the Polynesians transmitted this species from island to island, it being far more probable that they purposely propagated it inland from the native seacoast stock on the various islands. From personal experience over a period of more than eighteen years I am familiar with the entire Philippine group from northern Luzon to southern Mindanao, and have observed that throughout these islands *Hibiscus tiliaceus* is a characteristic species of the seashore, often being the dominant, or one of the dominant, species on the strand; it occurs not only on beaches contiguous to thickly settled areas but also on isolated and sparsely populated coasts, and on uninhabited islands and islets. From what I know of the Indo-Malayan region generally I am confident that the species occurs similarly on the tens of thousands of miles of coast line throughout tropical Asia, Africa, Malaya, tropical Australia, and many islands of the Pacific, as I have personally observed it in the Philippines and in the Marianne Islands. There can scarcely be any arguments as to other than its natural pantropic distribution, and claims to the contrary would appear to be not in conformity with the known facts regarding its occurrence and distribution in nature.

[381] Being thoroughly familiar with *Hibiscus tiliaceus* as it occurs in nature in the Old World, it is difficult for me to conceive how any botanist could seriously advance the argument that it is a native of tropical America transmitted to the Old World by the primitive Polynesians and, as a corollary, attempt to prove intercommunication between Polynesia and tropical America in prehistoric times on the basis of the present pantropic distribution of this species. That a limited intercommunication between Polynesia and tropical America did exist in prehistoric times is entirely probable, but to argue that the present distribution of *Hibiscus tiliaceus* supports this theory certainly does not strengthen the probability.

The generally accepted theory among ethnologists supports an *eastward* culture movement across the Pacific rather than a *westward* one. If the Cook *maho* series is related to the Polynesian *mao* series it would be much more reasonable to view it as coming from the Pacific to America rather than as evidencing a migration from America into the Pacific. If, as they claim, the American origin of *Hibiscus tiliaceus* is *even more clearly indicated* than is the similar origin of the coconut and the sweet potato, the claims to the American origin of the last two must be very weak indeed.

Their argument regarding the origin and distribution of *Hibiscus tiliaceus* is largely based on the similarity between its local names in tropical America and in Polynesia; namely, *maho, mahagua,* etc., in tropical America, and *mao, mau, vau,* etc., in Polynesia. About thirteen pages are devoted to a discussion of the philological questions involved. While many data are given to show the similarity of names in tropical America and Polynesia, it is stated that the names used in Fiji, Guam, and the Philippines may not belong to the *maho* series. The large number of Malay Archipelago names is ignored, but the statement is made that local names used in Madagascar and the neighboring islands appear to connect with the Malay and Polynesian series.

The recorded names for the species in the Philippines are *bago, bauan, balobago, balibago, malabago, malabagu, malambago, mayambago, mulabago, danglog, loago, hanot,* and *hanut;* of these *balibago* and *malabago* are the ones most commonly and widely used. The recorded names for the Malay Archipelago, not mentioned by Cook, are *balebirang, baoe, baoek, baroe, baroe bhender, haoe ai, haroe, kabaroe, kalimbaoean, kasjanaf, kawaoean, kelambaoean, kioko, lago, molombagoe, molowahoe, papatpat, pohon baoek, siroen, wahoe, wande, waoe, waroe, waroe* [382] *laoet* (*laoet* = ocean), *waroe lenga,* and *waroe lengis.* These names are from Dutch sources, and it should be borne in mind that in Dutch orthography *oe* represents the sound *u.*

As noted above, the authors state that it may be doubted whether names like *vahu, balibago,* and *pago,* used in Fiji, the Philippine Islands, and Guam, belong in the *maho* series, but consider that the relation seems possible in view of the intermediate Polynesian forms like *bago, faga,* and *haga.* They do not discuss the Malayan names enumerated above, but with the statement that they appear to connect with the Malayan and Polynesian series they list the following names from Madagascar and neighboring islands: *baro, var, varo, vau,* and *vaur.* Among the names in use in India, *bariá* and *baru* are suggestively like many of the Malayan, Mascarene, and Polynesian names.

Not being qualified personally to discuss the philological questions involved, and yet confident on purely botanical grounds that *Hibiscus tiliaceus* is a strand plant of natural pantropic distribution, at my request Prof. H. Otley Beyer, of the department of anthropology, University of the Philippines, and Mr. E. E. Schneider, of the Philippine Bureau of Forestry, have examined Cook's paper and my notes on which this article is based. Both of these men are authorities on Philippine languages and both are deeply interested in the comparative philology of Indo-Malayan, Philippine, and Polynesian languages. Professor Beyer, whom I first consulted, has called my attention to the fact that the Polynesian *mao* series may well have been derived from some of the Malayan forms by the suppression of consonants, which is a fundamental characteristic of the Polynesian group of languages as contrasted with the Malayan languages. It seems to me to be entirely probable that the original form or root in the Indo-Malayan region was some word like *bago* or *baru*. It is to be noted that with the substitution of *m, f,* and *v* for the initial *b,* and *h* for *g* or *r,* or the suppression of the latter two letters, we have a series of names that approximate the Polynesian *mao* series given by Cook as *mao, mau, au, hau, fau,* and *vau*. The probabilities are very great that all of the Polynesian *mao* series are merely modifications of the Indo-Malayan *bago* series; and that the Polynesians in their migration, having adopted the name while in the Indo-Malayan region, merely applied it to the wild plant which they found all over Polynesia. It would seem, therefore, that this root has nothing to do with the tropical American *maho* series, the resemblances being merely accidental. The *bago* origin of the *mao* [383] series is a great deal more likely than the *maho* origin, and infinitely more probable in view of the generally accepted theories as to the origin and migrations of the Polynesians. It is, moreover, not, as these authors contend, in violent opposition to the known distribution and occurrence in nature of the species under discussion.

Mr. Schneider is in full agreement with the *bago* or *baru* origin of the Polynesian *mao* series. He considers that one of the weakest spots in Cook's argument is the expressed doubt that the Fijian *vahu,* the Philippine *balibago,* and the Guam *pago* belong to the *mao* series. He states that the very wide distribution of the *bago* form in the Indo-Malayan region indicates that it is as near as we can get to the original root, whatever that may be. The fact that *r, g,* and *h* are interchangeable in certain series of words in most of the Indo-Malayan languages is as well established as is any of Grimm's laws in the European languages. He considers that there can be hardly any doubt that the Indian *baru* is identical with the Philippine *bago.* The final disappearance of the *h* when intervocalic is not uncommon in Tagalog and in other Philippine languages. Guam *p* for Philippine *b* is perfectly regular, as is *v.* Finally, the weakening of initial *b* to *m* is very common—for example, the plant names *banaba, manaba; binunga, minunga; batavia, matavia;* and, as to *malabago* itself, this is apparently nothing but a reduplicated form with weakened initial *b,* of which other examples are to be found, such as *matobato.*

As to the meaning and application of the name *maho* Mr. Schneider further points out that, whether it was originally the name of some bast-producing plant that was also applied to others that either produced bast or resembled them in external appearance, or a word primarily meaning

"bast" and "to tie," is perhaps a question which cannot be decided and, moreover, is of no great importance. The wide distribution of the word has nothing to do with this, however, the following notes indicating what seems to him to be a more probable alternative, namely, that "bast" is the original meaning of the word *maho*. *Bago,* to use now a Philippine name, is one of the most commonly used names for *Gnetum gnemon,* the bast of which is probably the strongest found in the Philippines and used wherever very strong cordage is desired. *Salago,* in which the same root occurs, is widely used for species of *Wikstroemia* and *Phaleria,* both producing a very fine and extremely tough bast. A parallel case is that of the other name, *hanot,* cited above for *Hibiscus* [384] *tiliaceus;* this, in very numerous forms, of which *banot, bonot, lanot, lanutan, wanoet* (Dutch spelling), *lapnot,* and *lapnit* are a few, is applied to even more numerous species of plants than is *bago,* but also invariably to plants producing some kind of bast fiber or tying material. Examples from widely different plants to which these names are applied are species of Annonaceae; representatives of Malvaceae; various species of vines, representing diverse families, which may either be used whole or which produce bast (*Bauhinia cumingiana*); palms having a network of fibers about the bast of leaf stalks; coir; the epidermal layers from the leaf sheaths of abacá (*Musa textilis*); and finally rattans. Mr. Schneider considers that these cases seem to indicate the derivation of the plant names from a common property rather than the derivation of names of various plants from a primitive or original name of a single species. Is not the American bass wood (bast-wood!) a perfectly analogous case?

It would seem that the argument of these authors as to the American origin of *Hibiscus tiliaceus* and its prehistoric distribution across Polynesia by the Polynesians to the Tropics of the Old World was based on erroneous assumptions on their part, from both a botanical and a philological standpoint, and that their deductions are not borne out by the facts in the case.

— IV —

ON THE FLORA OF BORNEO*

[18] . . . It has long been known that the flora of Borneo is not essentially different from that of the Malay Peninsula and the other islands in the Sunda group, notably Sumatra and Java and the contiguous smaller islands. Borneo naturally presents what must be considered, at least in part, the center of distribution of the typical Malayan flora. While it is certain that the Malay Peninsula, Sumatra, Borneo, and Java formerly comprised a single land mass, as indicated by their relative positions and the shallow seas separating them, yet they have been separated for a sufficiently long time to allow for the development of a high degree of endemism, not especially noticeable so far as genera are concerned, but very evident in regard to species, in each area. Unfortunately so little is known [19] regarding the flora of Sumatra that it is impossible to make any estimate regarding the endemism of its flora. In regard to Java, while its flora is relatively well known, the data in reference to the geographic distribution of its constituent species, approximating 5,000, is unfortunately not so arranged as to be available. On account of the extermination of the virgin forest over immense areas in Java it is very probable that its endemism will be found to be appreciably lower than that of other islands in Malaya. In the Philippines apparently about 60 per cent of the known species are confined to the Archipelago, but the percentage of endemic genera is distinctly smaller than is that of Borneo. In the Malay Peninsula[1] the specific endemism is apparently about 50 per cent. The endemism of the Bornean flora is then not radically different from that of the Malay Peninsula to the north-west or the Philippines to the north-east, and it is suspected that the floras of Sumatra, Celebes, and other large islands in Malaya will approximately conform to this percentage of endemism. As our knowledge of the Bornean flora increases it is almost certain that the percentage of endemism will be found to increase rather than to decrease as it seems to be apparent that more additions will be made to the known Bornean flora in the form of species as yet undescribed than in the discovery in Borneo of species already characterized from extra-limital collections. This expectation is based on the fact that the settled areas are much better explored botanically than are the forested regions; and it is a well established fact that in all parts of the Malayan region, the percentage of endemism is high in the forested regions and very low in the settled areas. Borneo presents in addition to its strictly and dominantly Malayan elements certain continental or boreal types; that is species otherwise known only from Asia, chiefly the mountains of India, and an interesting series of Australian types, but these Asiatic and Australian types are relatively speaking few in number and are nowhere dominant.

* Excerpts from the introduction to E. D. Merrill's, "A Bibliographic Enumeration of Bornean Plants" (Special Number for 1921 to the Journal of the Straits Branch of the Royal Asiatic Society, pp. 18-29, September 1921).

[1] Estimate based on an examination of the families *Caprifoliaceae* to *Verbenaceae* inclusive, as treated in King & Gamble's Materials for a Flora of the Malayan Peninsula (reprint) 4 (1903-09) 1-916.

In examining the list of Bornean species as to their extra-Bornean distribution it is but natural that we find certain ones which are known only from Borneo and from but one or two of the surrounding regions. Thus lists could be compiled of those species known only from Borneo and Java; Borneo and Celebes; Borneo and Sumatra; Borneo and the Malay Peninsula; Borneo and the Philippines, Borneo and Indo-China, but any interpretations of such list must be strictly limited by our own [20] ignorance of the Bornean flora as a whole, as well as our very imperfect knowledge of the vegetation of some of the surrounding regions. Thus species reported only from the Malay Peninsula and Borneo approximate 300, while those known only from Java and Borneo are but about 110. While we might infer from this that the Bornean flora is more closely allied to that of the Malay Peninsula than to that of Java, yet I suspect that the explanation of the difference between the two lists lies largely in the fact that Borneo-Malay Peninsula material has been much more compared in working up the flora of the latter region than has Borneo-Java material in the work done on the Javan flora.

I have already indicated that the Sumatran flora is too little known to warrant drawing any definite conclusions regarding the relationships between the floras of Sumatra and Borneo. The indications are that the floras of these two large islands closely resemble each other as would be expected from their relative positions, the shallow sea separating them, and the intervening islands of Banca and Billiton. About 98 species are reported only from Sumatra and Borneo, but very few genera have this limited distribution.

It is interesting to note that about 135 species are reported from but not beyond the Malay Peninsula, Sumatra and Borneo, emphasizing the fact that these regions present much in common so far as their flora is concerned, and indicating their former union in one land mass in past geologic times; a number of genera are confined to these three regions. A similar list could be compiled of those species known from the three regions mentioned and Java; and from the Malay Peninsula, Borneo, and Java; but most of those species now reported from the Malay Peninsula-Borneo-Java are almost certain to occur in Sumatra, as are those reported only from Java-Sumatra, or Java-Malay Peninsula, or even Malay Peninsula-Sumatra, to occur in Borneo.

From the geographic position of the Philippines to the north-east of Borneo and with two definite lines of connecting islands between Borneo and the Philippines, the Sulu Archipelago to the south and the Palawan-Calamianes-Mindoro groups to the north, we might logically infer that much of our present Philippine flora had been derived from Borneo through previously existing land-connections. In the known geographic distribution of a few species, Malay Peninsula-Borneo-Philippines, and Malay Peninsula-Sumatra-Borneo-Philippines it is perhaps evident that there has been a certain part of the Philippine flora derived from this source. However, the list of species with the limited geographic distribution of Borneo-Philippines is comparatively small, about 60 and a [21] number of them do not reach the Philippines proper but at most extend in the south as far as western or central Mindanao and in the north to Palawan or Mindoro only.

Furthermore the only genera known from and confined to Borneo and the Philippines are *Clemensia, Hallieracantha, Philbornea,* and *Beccarianthus.* The Borneo-Philippine list then is much smaller in species of limited distribution and very much smaller in genera of such distribution than are the corresponding Philippine-Celebes or Philippine-Molucca lists; and the flora of Celebes and the Moluccas generally is no better known, and is perhaps less perfectly known, than is that of Borneo. So far as the origin of the Malayan element in the Philippine flora is concerned, the preponderating evidence is that it has been derived from the islands to the south and south-east of the Philippines rather than from the nearer and apparently closer geographically allied Island of Borneo.

The Asiatic types in the Bornean flora are chiefly if not entirely those confined to the higher mountains. These species probably reached Borneo during one of the glacial periods when there was a more or less general migration of northern types to the south. In former geologic times they may have occurred in Borneo at lower altitude but now find the climatic conditions to which they are adapted only at higher altitudes, notably on Mount Kinabalu. Among these northern types may be mentioned *Viola serpens* Wall., *Potentilla* (three species), *Lactuca retrosidens* Merr., *Aletris, Sanicula, Scirpus clarkei, Carex, Gentiana* (two species), *Agrostis* (two species), *Poa epileuca* Stapf, and *Deschampsia flexuosa* Trin. The Asiatic element in Borneo is comparatively weak however, as compared with that of the mountains of Java (which may be largely due to insufficient exploration of Borneo) and especially in comparison with that of the mountains of Northern Luzon.

Perhaps the most interesting extra-Malayan element in the Bornean flora is the Australian one. This is not so pronounced as is the same element in the Philippine flora, but again this may be largely due to our own ignorance of the Bornean flora due to insufficient exploration. The Australian types are not confined to the higher altitudes although they are predominatingly so, for *Osbornia octodonta* F. Muell., and *Camptostemon* (*Vidalia*) *philippinense* Becc. both occurring in the mangroves are definitely Australian types; the former, a monotypic genus was previously known only from the Philippines and Australia, and the latter presents two species, one Australian, the other also previously known only from the Philippines; *Faradaya,* of which one species has recently been found in Borneo presents its other species in the regions to the south-east of Borneo, New Guinea, Australia, and Polynesia. [22] Other typically Australian genera of which species have been found in Borneo, but which are also of general distribution in Malaya are *Casuarina, Helicia, Baeckea, Leptospermum, Melaleuca* (probably introduced in Borneo), *Tristania, Styphelia, Halorhagis,* perhaps *Dianella,* and possibly representatives of other genera such as *Dipodium.* It is not always clear whether such types as these are really of Australian origin, or whether they originated in the Indo-Malayan region and migrated to Australia. Judged however from the predominence of other representatives of these and their allied genera in Australia they may with a fair degree of certainty be classed as Australian types.

Striking Australian types found at higher altitudes include *Ranunculus lowii* Stapf, *Drimys piperita* Hook. f., *Didiscus saniculaefolius* (Stapf)

Merr., *Coprosma crassicaulis* Stapf, *C. hookeri* Stapf, *Nertera depressa* Banks, *Lagenophora gibbsiae* Merr., *Gaultheria borneensis* Stapf, *Euphrasia borneensis* Stapf, *Drapetes ericoides* Hook. f., *Patersonia lowii* Stapf, *P. borneensis* Stapf, *Centrolepis kinabaluensis* Gibbs, *Scirpus inundatus* Spreng., *Schoenus kinabaluensis* Stapf, *S. melanostachyus* R. Br., and *Blechnum fraseri* Luerss. Of these the genera *Drimys, Didiscus, Drapetes, Patersonia, Schoenus* and *Centrolepis* are typically Australian, but representatives of all except *Drapetes* have been found in the Philippines; they are not otherwise known from Sunda Islands and the Malay Peninsula but some of these are known from Celebes and from New Guinea, a distribution wholly to be expected of all of them.

From a systematic standpoint, with the exception of a few comparatively small areas, the flora of no part of the immense Malayan region can be considered as thoroughly known or even as well known. Among the larger islands in Malaya proper Java is the only one that has been intensively explored from a botanical standpoint, and the flora of Java is by no means thoroughly known although botanical exploration of this island has extended over a period of more than one hundred and fifty years, and an enormous amount of work has been done on its flora within the past century. Among the smaller islands probably Penang and Singapore are the only ones that we can consider to be well explored, and on both of these intensive botanical exploration has been intermittently carried on for over one hundred years; in Singapore, at least, the original vegetation has now been largely exterminated. Parts of the Malay Peninsula have been well explored, but large areas have scarcely been visited by any botanist or collector, and while the flora of the Malay Peninsula is better known than is that of any other considerable area in Malaya, other than Java, future exploration of the more inaccessible parts of the Penin-[23]sula will certainly yield a great many additions to its known flora. The large island of Sumatra is practically unknown from a botanical standpoint, although extensive collections have been made there in the past, and important contributions to a knowledge of its flora have been published; exploration, however, has been intermittent and limited to certain small areas. The flora of Celebes and of other islands in the Archipelago proper is no better known, while the explorations made in New Guinea within the past twenty-five years, so far as the collections have been worked up, give us but a very imperfect conception of the great richness of its flora. In the Philippines great progress has been made in botanical exploration and publication in the past sixteen years, and in that time the list of known species has been more than trebled, yet with all that has been accomplished in the Philippines in recent years, current collections from previously unexplored regions invariably present a high percentage of additions to the known flora, so that it is improbable if we now actually know more than three-fourths of the species that occur in the Archipelago.

The flora of Malaya is an exceedingly rich one in families, in genera, and in species, and the region presents an infinite number of interesting problems from the standpoint of phytogeography. It is very probable that the entire Malayan flora from the Malay Peninsula to the Philippines and New Guinea, when fairly well known, will approximate 40,000 species of plants in the higher groups alone, but it will be many years before even an

approximately complete list can be compiled for enormous areas remain to be explored, and the collections made must be critically studied and compared with material from other parts of this vast area. While a certain number of species are generally distributed throughout the entire extent of Malaya, these are, in large part, the coastal forms, and those found in the settled areas where the character of the original vegetation has been profoundly altered by man and his agricultural activities. In the virgin forest in practically every island, at least in those islands of any considerable size, so far as our present available data show, there is always or nearly always a high percentage of endemism; further in different parts of the same island, depending on local climatic conditions and apparently largely on the seasonal distribution of the rainfall throughout the year, there is very frequently a marked local endemism, the vegetation of one area presenting a high percentage of species entirely different from those found in another area often only a few miles distant. Even mountains which are separated by plains or arms of the sea only a few miles in width often differ markedly in their vegetation. Thus in the Philippines Mounts Maquiling, Banajao, and Mariveles, [24] in Luzon, all extinct volcanoes, each one plainly visible from the other and each supporting a characteristic type of primeval forest each presents a fairly large number of species, at approximately similar altitudes, that have not been found on either of the other two.

In regard to the high altitude flora of the Philippines most of our higher mountains present a certain number of species in common. The tendency is for each mountain, at least those peaks that are widely separated, and those located on different islands, to present a marked local endemism. This will doubtless prove to be true for the whole Malayan region, or at least in many parts of this vast area.

Again in Verde Island passage between Luzon and Mindoro, which is only seven and one-half miles wide in its narrowest part, in March to June the Batangas shore is always brown and barren looking while the Mindoro coast supports a most luxuriant type of vegetation, green and fresh at all seasons. Epiphytes such as *Asplenium nidus* occur on the Mindoro coast in mangrove trees overhanging tidal streams, which occur in the opposite parts of Batangas only at and above an altitude of about 2,000 feet; in this case the explanation of this diversity in vegetation in areas separated by only a narrow arm of the sea is that Batangas is subject to a prolonged dry season while on the opposite coast of Mindoro rains are more or less frequent in all months on account of the high mountains of Mindoro situated not far from the coast. The disposition of mountain masses has a marked effect on the seasonal distribution of the rainfall, and thus an equally marked effect on the nature of the vegetation at low altitudes in the vicinity of such mountains. In Malaya there is doubtless a large number of local and not widely separated areas that present contrasts in their vegetation as striking as the one mentioned above.

Again the geologic formation in relation to the vegetation must be considered, the flora of areas of volcanic origin being rather strongly differentiated from that of limestone regions; while such regions present many species in common, others are characteristic of the limestone areas and are scarcely to be found on other geologic formations. The richness of a local

flora is naturally always greater in those regions where there is a considerable range in altitude, and the forested areas are usually much richer in species than are the open grasslands and settled areas.

The tropical forest characteristic of most parts of Malaya is exceedingly complex. In the Philippines an examination of the stand on definite areas may show more than one hundred different kinds of trees on as small an area as one-fourth of a [25] hectare, and what is true of an average Philippine forest is at least approximately true of other forested areas in Malaya. In the eastern tropics gregarious forests scarcely exist except in the mangrove swamps, in those countries where pines occur, in certain countries where teak grows, and in some types of dipterocarp forests such as the sal of India and Burma; other dipterocarp forests approach the gregarious type.

The complexity of primary or virgin equatorial forests is excellently indicated by the following quotations from Alfred Russell Wallace:[2]

"The observer new to the scene would perhaps be first struck by the varied yet symmetrical trunks, which rise up with perfect straightness to a great height without a branch, and which, being placed at a considerable average distance apart, give an impression of some enormous building. Overhead, at a height, perhaps, of a hundred and fifty feet, is an almost unbroken canopy of foliage formed by the meeting together of these great trees and their interlacing branches; and this canopy is so dense that but an indistinct glimmer of the sky is to be seen and even the intense tropical sunlight only penetrates to the ground subdued and broken up into scattered fragments. . . . The great trees we have hitherto been describing form, however, but a portion of the forest. Beneath their lofty canopy there often exists a second forest of moderate-sized trees, whose crowns, perhaps forty or fifty feet high, do not touch the lowermost branches of those above them. . . . Yet beneath this second set of medium-sized forest trees there is often a third undergrowth of small trees from six to ten feet high, of dwarf palms, of tree-ferns, and of gigantic herbaceous ferns. Yet lower, on the surface of the ground itself, we find much variety."

Terrestrial herbaceous plants may be entirely absent, or may be fairly abundant, depending on local climatic conditions. The number of species of these is usually not great. Lianes are frequently abundant, clambering into the tops of the highest trees. Epiphytes, depending on the relative humidity, may or may not be abundant or conspicuous.

Many forested areas in Borneo conform to the general characters indicated above, but in large areas the primary or virgin forest has largely been destroyed, or its character profoundly altered by the activities of the native population. Miss Gibbs in speaking of the vegetation of the interior of British North Borneo enroute to Mount Kinabalu notes[3] that: "The whole country with its endless hill ranges, ranging from 3,000- [26] 5,000 feet, is covered with what may be called a well worked secondary forest;" and again: "Certainly the 'untrodden jungle' of fiction seems to be as non-existent in this country as the 'rain forest' of science."

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[2] Natural Selection and Tropical Nature (1895) 240, 243, 244.

[3] Journ. Linn. Soc. Bot. 42 (1914) 9, 10.

The swamp forests differ radically from the hill forests in their constituent species, while on the mountains there is a very radical change in the nature of the forest and in its constituent species at an average altitude of from 2,500 to 3,000 feet. Naturally under these complex conditions botanical exploration is by no means an easy task and thoroughly to explore any given area involves intensive field work not only in all months of the year, as only a part of the numerous species can be found in flower or in fruit at any one time; but in order to insure the collection of most of the species in a given area, the work must be continued over a period of several years. While some species are abundant, others are rare, and in certain groups, notably the *Bambuseae* and *Dipterocarpaceae* many species produce flowers only at intervals of several years.

Botanical exploration of these exceedingly complex forests is made more difficult by the great size of the trees; their usually inconspicuous flowers; and the great difficulties encountered in determining what tree is in flower or in fruit from the fallen parts observed on the ground. Frequently the only possible expedient to follow is to fell the suspected tree, which is usually by no means an easy task, and very often when the trunk is cut the tree will not fall on account of the support given by its neighbours and the tangle of lianes uniting its top with those of other trees. Similarly it is equally difficult to detect flowers or fruits on the large lianes which clamber to the tops of the higher trees, and it is practically impossible to locate flowering or fruiting specimens of the smaller and often numerous epiphytes.

From the standpoint of phytogeography it is perhaps to be regretted that in the past fifty years so much attention has been devoted to the botanical exploration of such an island as Java, the flora of which is comparatively well known, and so little attention given to the immensely larger areas in Malaya which are practically *terra incognita* from a botanical standpoint, such as most of the great Island of Sumatra, most parts of Borneo, Celebes, Sumbawa, Flores, Timor, Ceram, Gilolo, New Guinea, and numerous smaller islands. The continued exploration of Java will doubtless add a fairly large number of species to its known flora, but the return to be expected from field work in Java, compared with what must follow intensive field work in any previously unexplored area in the islands mentioned above, can but prove insignificant. Up to the close of the last century [27] our knowledge of the Philippine flora was, comparatively speaking, somewhat less than our present knowledge of that of Borneo, but was distinctly in excess of our present knowledge of the Sumatran flora as well as that of most other parts of Malaya, except Java and the Malay Peninsula. Intensive exploration of the Philippines during the past sixteen years has yielded material on which the descriptions of about 5,000 previously undescribed species have been based, and the field in this respect is by no means exhausted. Current collections of Philippine plants continue to yield a high percentage of plants new to the Archipelago, in striking contrast to current collections of Javan plants, where the percentage of additions to the known flora is very low. Certainly the Philippine flora is no richer area for area than is that of any of the larger islands in Malaya, and what has proved true in regard to Philippine exploration will likewise prove true in the future exploration of the lesser known parts of Malaya.

It is urgent that such exploration be undertaken at no distant date if we are to gain an adequate knowledge of many elements of the Malayan flora. It is only necessary to examine most parts of Java below an altitude of 4,000 feet, such islands as Singapore, immense areas in the Malaya Peninsula, and the settled areas generally in the whole Malayan region in order to gain some appreciation of the disastrous effects of man's activities on the floras of these regions. It is a well known fact that where the virgin or primary forest is once destroyed in the Eastern tropics, the areas practically never revert to the original type of vegetation, at least in any reasonable amount of time. If the cleared lands are abandoned, as they frequently are by the primitive native agriculturist, they are quickly occupied by grass formations, usually lalang (*Imperata*); bamboo formations; or complex second growth forests in constituent species entirely different from the primary or virgin type. The pressure on the primary forest is rapidly increasing in many parts of Malaya, not only by the increase in the native Malay population, and the resultant demand for more agricultural lands, but also in the demands of modern industries for increased production in such commodities as rubber and copra and for other tropical products such as sugar, tobacco, fibers, coffee, tea, and other staples. Since the beginning of the present century immense areas in the Malay Peninsula, in Sumatra, in the Philippines, and doubtless in Borneo and in other parts of Malaya have been denuded of their original vegetation to provide place for modern plantations, and it is safe to assume that most such areas will never again be occupied by primary forests. The enormous trees and shade plants characteristic of the primary forest cannot persist under the [28] conditions demanded by modern agriculture, and they cannot exist in the second growth forests, grass lands, and bamboo thickets that rapidly encroach on cleared areas that are abandoned. Perhaps without realizing the fact we are witnessing in our own generation the rapid extermination of some of the noblest types of tropical vegetation and all botanists should be interested in preserving at least herbarium records while such records are to be secured. The present century will certainly witness an enormous extension of the agricultural areas in Malaya, for modern science has rendered our "conquest of the tropics" a comparatively simple matter; and any general extension of agricultural areas will to a large degree be at the expense of regions now covered with forests of one type or another.

It is true that many areas unsuitable for agricultural pursuits will continue to support various types of primeval vegetation but the vast primary forests situated on level alluvial lands are with equal certainty doomed to an early destruction. In Java, for example, it is doubtless true that species once common have become extinct or at least very rare within the past century by the destruction of primary forests over large areas. While definite proofs of such a contention might be very difficult or impossible to compile, yet I believe that it must be admitted by all experienced observers that sometime in the past Java was largely covered with a primary forest of one type or another; of this only slight traces now exist below an altitude of about 4,000 feet. In Java the pressure of the population has been the chief agent in the restriction, or in most parts of the island, the destruction of the primary forest, and it is only a question of time when the same agent will

exercise its full force in the now thinly populated larger areas such as the Malay Peninsula, Sumatra, and Borneo. It is becoming more and more imperative that the virgin forests of the Malay Peninsula, Sumatra, Borneo, and other parts of Malaya be botanically explored, not only because we need the data such collections will yield to help us solve the numerous problems of phytogeography and taxonomy, but also because numerous species that can now be secured without any great difficulty, will in the course of time become exceedingly rare, very local, or in some cases entirely extinct.

My appreciation of these conditions is largely based on my own experiences and observations in the Philippines during sixteen years' residence and exploration of the group, and the Philippine conditions are certainly not radically different from those in other parts of Malaya. It cannot be too strongly urged on those in authority, that provision should be made for an intensive botanical exploration of the accessible parts of Malaya, [29] especially in those parts where the extension of agricultural areas is now most rapid.

While an early and intensive botanical exploration of the less known parts of Malaya is an urgent necessity, what is of still greater importance is the establishment of forest reserves. These reserves should be selected and supervised for the definite purpose of preserving to posterity the characteristic types of primary forests characteristic of regions in which the reserves are made. For this definite purpose extensive reserves are not necessary, but they might be made in connection with larger ones established for insuring a constant timber supply in those regions now being opened up to settlement and in which the primary forests are now rapidly being destroyed. Forest reserves have been established in the Malay Peninsula and in Java, and wherever possible these should be extended, rather than restricted, and the general policy of establishing them should be adopted as the more distant and at present more or less inaccessible regions are opened to civilization. . . . .

— V —

DIE PFLANZENGEOGRAPHISCHE SCHEIDUNG VON FORMOSA UND DEN PHILIPPINEN*

[599] Die Insel Formosa, die in Sicht der nördlichsten Insel des Philippinen-Archipels, L'Yami, liegt, wurde mit ihr früher in eine gemeinschaftliche botanische Provinz Philippinen-Formosa vereinigt. Die gesammten biologischen Tatsachen zeigen jedoch, dass die Formosa-Elemente in Wahrheit wenig Gemeinschaft mit denen der Philippinen haben, ihre verwandtschaftlichen Verbindungen vielmehr nach dem asiatischen Festlande weisen. Aus diesem Grunde können Formosa und die Philippinen trotz der geographischen Nachbarschaft nicht in dieselbe botanische Provinz gestellt werden.

Für diese Frage ist zunächst zu erwähnen, dass Formosa von der nördlichsten Insel der Philippinen-Gruppe durch einen tiefen Meereskanal getrennt ist, während andererseits Formosa der kontinentalen Küstenbank aufliegt. Der Formosa-Kanal zwischen dieser Insel und der asiatischen Küste zeigt nirgends grössere Tiefe als 150 m. Vom geologischen Standpunkt ist es erwiesen, dass seit dem Beginn der Tertiärperiode keine direkte Verbindung zwischen Formosa und den Philippinen bestanden hat. Die biologischen Tatsachen bestätigen diese geologischen Verhältnisse.

Es ist zu vermuten, dass die Floren von Formosa und den Philippinen nur wegen ihrer räumlichen Nachbarschaft in dieselbe botanische Provinz gebracht wurden und nicht auf Grund direkter Vergleiche der Floren, die ja auch erst vor kurzem möglich wurden, da vorher, d. h. bis zu den Jahren 1917—1922, die nötigen Daten nicht in übersichtlicher Form vorhanden waren.

Glücklicherweise ist jetzt die Flora von Formosa für vergleichende Untersuchungen hinreichend gut erforscht, besonders dank der Arbeiten von Dr. B. HAYATA sowie anderer japanischer Botaniker.

In 1917 publizierte HAYATA[1] seinen Generalindex über die Formosaflora, bestehend aus einer systematischen Zusammenstellung aller Blüten-[600]pflanzen und Farne von Formosa, welche bis zur Publikation des sechsten Teiles seiner Icones Plantarum Formosanarum (1917) angegeben waren. Seit 1917 sind vier weitere Fortsetzungen der Icones erschienen.[2] Im Generalindex, welcher die Pteridophyten einschliesst, werden 3,446 Arten als auf Formosa vorkommend angeführt. Die Fortsetzungen in den vier weiteren, seit 1917 erschienenen Teilen der Icones, bringen die Gesamtzahl der Arten auf 3,658, die sich auf 1,185 Genera und 170 Familien verteilen (nach dem System und der Einteilung von BENTHAM und HOOKERS Genera Plantarum). Besonders zu erwähnen ist, dass in obigen Zahlen die Pteridophyten eingeschlossen sind. Bei Durchsicht der HAYATAschen Liste

* E. D. MERRILL, "Die pflanzengeographische Scheidung von Formosa und den Philippinen" (Engler's Botanische Jahrbücher 58:599-604, 1923).

[1] HAYATA, B., General Index to the Flora Formosa (1917) 1-155.

[2] HAYATA, B., Icones plantarum Formosanarum, Bd. VII (1918) 1-107, t. 1-141, f. 1-69; Bd. VIII (1919) 1-164, t. 1-15, f. 1-88; Bd. IX (1920) 1-155, t. 1-7, f. 1-55; Bd. X (1921) 1-74, f. 1-48.

finden wir, dass bestimmte Familien, welche in Formosa einheimische Vertreter haben, auf den Philippinen gänzlich ohne Vertreter sind, nämlich die folgenden: *Valerianaceae, Betulaceae, Trochodendraceae, Lordizabalaceae, Dipsacaceae, Monotropaceae, Diapensiaceae, Styracaceae, Myoporaceae* und die *Philydraceae*. Weiter zeigt sich ein noch grösserer Gegensatz darin, dab bestimmte Familien, die auf den Philippinen zahlreiche Genera und Arten, oder wenigstens zahlreiche Arten besitzen, wie z. B. *Anonaceae, Meliaceae, Guttiferae, Sterculiaceae, Burseraceae, Combretaceae, Myrtaceae, Gesneraceae, Bignoniaceae, Piperaceae, Sapotaceae, Melastomataceae, Begoniaceae, Pandanaceae, Palmae* u. a. m., auf Formosa nur sehr spärlich vertreten sind. Andererseits sind die Familien *Ranunculaceae, Berberidaceae, Cruciferae, Papaveraceae, Violaceae, Caryophyllaceae, Aquifoliaceae, Celastraceae, Rosaceae, Saxifragaceae, Crassulaceae, Umbelliferae, Caprifoliaceae, Campanulaceae, Gentianaceae, Pinaceae* und die *Liliaceae* in Formosa bedeutend zahlreicher vertreten, als in den Philippinen. Bei dieser Sachlage ist besonders zu bemerken, dass die in der ersten Reihe aufgeführten Familien besonders für tropische Regionen charakteristisch sind, wogegen die in der zweiten Reihe aufgeführten mehr für gemässigte Regionen bezeichnend sind.

Oben habe ich erwähnt, dass verschiedene Pflanzenfamilien mehrere einheimische Vertreter auf Formosa, aber keine Repräsentanten auf den Philippinen haben. Im Gegensatz zu diesen sind die folgenden Familien der Philippinen zu nennen, von denen keine Vertreter in Formosa bekannt sind: *Triuridaceae, Centrolepidaceae, Monimiaceae, Nepenthaceae, Cunoniaceae, Erythroxylaceae, Dichapetalaceae, Stackhousiaceae, Gonystylaceae, Ochnaceae, Dipterocarpaceae, Datiscaceae, Clethraceae, Epacridaceae, Salvadoraceae* und *Stylidiaceae,* zum grössten Teil charakteristisch-tropische Gruppen. Den merkwürdigsten Fall darunter bildet die Familie *Dipterocarpaceae,* deren Verbreitungszentrum anscheinend Borneo ist, und welche in den Philippinen durch 9 Genera mit 50 Arten vertreten ist. Die grossen Bäume [601] dieser Familie sind die dominanten Vertreter des Urwaldes und allgemein über die ganzen Philippinen verbreitet, ebenso wie über Borneo, Sumatra und die Malayische Halbinsel. 5 Gattungen, nämlich *Anisoptera, Hopea, Pentacme, Shorea* und *Vatica* erstrecken sich mit je einer Art nördlich bis zu den Babuyanes-Inseln, zwischen Luzon und Formosa, jedoch keine Art kommt in Formosa vor.

Von den ungefähr 950 Gattungen von Blütenpflanzen, die in Formosa einheimische Repräsentanten besitzen, haben nicht weniger als 225 keine Vertreter in den Philippinen. Unter den Genera befinden sich so typische und charakteristische Vertreter der gemässigten Zonen, wie *Abies, Chamaecyparis, Cunninghamia, Juniperus, Libocedrus, Picea, Pseudotsuga, Tsuga, Grillium, Smilacina, Aira, Alopecurus, Apios, Astragalus, Lotus, Vicia, Agrimonia, Cotoneaster, Malus, Pirus, Potentilla, Sanguisorba, Sorbus, Spiraea, Mitella, Parnassia, Ribes, Saxifraga, Circaea, Angelica, Apium, Bupleurum, Pimpinella, Peucedanum, Hedera, Cornus, Abelia, Cephalanthus, Petrinia, Valeriana, Gerbera, Petasites, Taraxacum, Chimaphila, Moneses, Pieris, Pyrola, Monotropa, Primula, Aconitum, Coptis, Podophyllum, Nuphar, Corydalis, Arabis, Dianthus, Silene, Cuscuta, Paulownia, Pedicularis, Orobanche, Elsholtzia, Glechoma, Lamium, Pru-*

nella, Asarum, Humulus, Ulmus, Juglans, Alnus, Carpinus, Corylus, Fagus und viele andere.

In starkem Gegensatz dazu finden wir, dass ungefähr 1,400 Gattungen von Blütenpflanzen einheimisch in den Philippinen vertreten sind, von denen 660 auf Formosa fehlen.

Nicht eine einzige Gattung ist bekannt, welche nur auf die Philippinen und Formosa beschränkt ist, auch ist nur eine relativ kleine Anzahl von Arten erwähnt, die diese soweit erkannte beschränkte Verbreitung haben. Diese Tatsache ist besonders merkwürdig im Hinblick auf die geringe Entfernung zwischen den Philippinen und Formosa und auf die sehr ähnlichen klimatischen und physiographischen Verhältnisse, besonders zwischen Formosa und Nord-Luzon. Die genaue Untersuchung der HAYATAschen Liste, in Verbindung mit zahlreichen vergleichenden Herbariumstudien, die ich vornahm, und wobei ich Gelegenheit hatte, ziemlich umfangreiches Formosamaterial mit solchem von den Philippinen zu vergleichen, ergaben eine Reihe von ungefähr 40 Arten, die nur von den Philippinen und Formosa bekannt sind. Ein hoher Prozentsatz von den gemeinsam auf Formosa und den Philippinen auftretenden Arten findet sich jedoch in den Philippinen nur im nördlichen Zentral-Luzon, z. B. *Pterospermum niveum* Vid. (*P. formosanum* Mats.), *Ryssopteris Cumingiana* Juss., *Fagara integrifoliola* Merr., *Coriara intermedia* Mats., *Acacia confusa* Merr., *Deutzia pulchra* Vid., *Astronia pulchra* Vid., *Sarcopyramis delicata* C. B. Rob., *Aralia hypoleuca* Presl., *Alsomitra integrifoliola* Hay., *Boerlagiodendron pectinatum* Merr., *Viburnum luzonicum* Rolfe, *Lasianthus Tashiroi* Mats., [602] *Isanthera discolor* Max., *Ainsiaea reflexa* Merr., *Gynura elliptica* Yabe und Hay., *Gaultheria Cumingiana* Vid., *Isanthera discolor* Mats., *Palaquium formosanum* Hay., *Hypoestis Cumingiana* F.-Vill., *Callicarpa formosana* Rolfe, *Scutellaria luzonica* Rolfe, *Knema glomerata* Merr., *Myristica simiarum* ADC., *Illigera luzonensis* Merr., *Macaranga dipterocarpifolia* Merr., *Euphorbia Makinoi* Hay., *Elatostema edulis* C. B. Rob., *Lilium philippinense* Bak., *Eriocaulon Merrillii* Ruhl., *Isachne debilis* Rendle, *Rourea volubilis* Merr., *Stellaria laxa* Merr., *Bergia serrata* Blanco, *Aglaia elliptifolia* Merr. und *A. formosana* Hay.

Eine grössere Anzahl von weiter verbreiteten Arten erstrecken sich von Japan oder den Liu Kiu-Inseln bis nach China, Formosa und den Philippinen. Ebenso jedoch wie die Arten der vorhergehenden Liste werden diese speziell in Nord- und Zentral-Luzon gefunden, und sind in unserem Gebiet nur in mittleren und höheren Gebirgen verbreitet. Dazu gehören die folgenden Arten: *Sageretia theezans* Brongn., *Celastrus diversifolius* Hemsl., *Ilex asprella* Hance, *Ilex crenata* Thunb., *Pistacia chinensis* Bunge, *Acalypha australis* L., *Skimmia japonica* Thunb., *Evodia meliaefolia* Benth., *Rhynchosia volubilis* Lour., *Desmodium Buergeri* Miq., *Cocculus trilobus* DC., *Salvia scaphiformis* Hance, *Bothriospermum tenellum* F. u. M., *Lactuca dentata* C. B. Rob., *L. indica* Linn., *Eupatorium Lindleyanum* DC., *E. Reevesii* Wall., *E. japonicum* Thunb., *Artemisia capillaris* Thunb., *A. japonica* Thunb., *Clerodendron trichotomum* Thunb., *Androsace umbellata* Merr., *Acanthopanax trifoliatus* Merr., *Melastoma candidum* Don, *Scolopia Oldhami* Hance, *Columella corniculata* Merr., *Ampelopsis heterophylla* S. u. Z., *Photinia serrulata* Lindl., *Polygonum benguetense* Merr.,

Boehmeria densiflora H. u. A., *Saururus chinensis* Baill., *Potamogeton Maackianus* A. Benn., *Tripogon chinensis* Hack., *Carex ligata* Boott, *C. tristachya* Thunb., *Phoenix Hanceana* Naud., *Acorus gramineus* Sol., *Asparagus lucidus* Lindl., *Aletris spicata* Franch., *Lilium longiflorum* Thunb., *Liriope graminifolia* Bak. und *Ophiopogon japonicus* Ker.

Auch etwas weiter verbreitete Arten in den Gattungen *Solidago, Aster, Anemone, Boenninghausenia, Deschampsia, Agrostis, Viola, Ellisiophyllum, Peracarpa, Senecio, Hemiphragma* u. a., von welchen einige bestimmt als Himalaya-Typen angesehen werden müssen (z. B. *Anemone vitifolia, Peracarpa, Ellisiophyllum, Hemiphragma*) kommen gleichfalls in Formosa und in den Bergen von Nord-Luzon vor. Diese Himalaya-Typen, die auch in Formosa und Luzon einheimisch sind, stellen die südöstlichsten Ausläufer der Himalaya-Flora dar, und viele erreichten zweifellos Formosa, als es noch ein Teil des asiatischen Kontinents war, und wahrscheinlich in einer so weit zurückliegenden Zeit, dass sie auch Luzon erreichen konnten, d. h. als Luzon noch mit Formosa verbunden war. Diese Zeitperiode lag im frühen Tertiär, ehe die Formosaspalte, die heutige Bashi-Meerenge, bestand.

[603] Die australischen Elemente sind ebenfalls relativ gut in den Philippinen vertreten, verschiedene Arten erstrecken sich bis Nord-Luzon. Als australische Repräsentanten wären die folgenden Gattungen zu nennen: *Calogyne* (auch in der Provinz Fukien, China), *Stylidium, Centrolepis, Stackhousia, Microlaena, Cladium, Uncinia, Pleiogynum, Phrygilanthus, Citriobatus, Quintinia, Eucalyptus, Xanthostemon, Osbornia, Leptostemon, Camptostemon, Petersonia, Didiscus* und *Clianthus,* die alle in den Philippinen durch einheimische Arten vertreten sind. Diese australischen Elemente sind in Formosa sehr schwach vertreten; sie beschränken sich auf *Halorrhagis,* die phyllodine *Acacia confusa* Merr. (Formosa und Luzon), *Schoenus falcatus* R. Br. und *Ipomoea polymorpha* R. u. S. (Formosa, Nord-Luzon und Nord-Australien). Dies sind ungefähr die einzigen australischen Typen, die man von Formosa kennt. *Oreomyrrhis* hat 1 Art in Formosa, 1 in Borneo und verschiedene in Australien, Neu-Seeland und Süd-Amerika, jedoch keine Art in den Philippinen. *Myoporum,* eine hauptsächlich, doch nicht völlig australische Gattung, ist in Formosa durch 1 Art vertreten, während von den Philippinen oder aus dem malayischen Gebiet kein Vertreter dieser Gattung bekannt ist. Die stärker entwickelten papuasischen, celebischen und molukkanischen Elemente in der Philippinen-Flora sind von Formosa vollständig abwesend, obgleich viele sich bis Nord-Luzon und einige (*Wallaceodendron*) bis zu den Babuyanes-Inseln erstrecken.

Der Philippinen-Archipel zeigt hauptsächlich eine malayische Flora, und diese malayischen Elemente sind abzuleiten im Südwesten von den Sunda-Inseln, im Süden und Osten von Celebes, den Molukken und Neu-Guinea. Eine Untersuchung über die Verbreitung der Gattungen von Blütenpflanzen zeigt folgende bemerkenswerte Resultate.

Von einer Gesamtsumme von 365 Gattungen, die im westlichen malayischen Archipel oder den Sunda-Inseln, d. h. den Inseln westlich der Macassar-Strasse und der Lombok-Passage vorkommen, werden 218 oder ungefähr 61% in den Philippinen gefunden, treten jedoch nicht auf den südlich

der Philippinen gelegenen Inseln und östlich der Macassar-Strasse auf. 225 Gattungen, welche keine Repräsentanten auf den Sunda-Inseln haben, finden sich auf Celebes, den Molukken und Neu-Guinea. Von diesen haben 65 (oder 28%) Vertreter in den Philippinen. Unsere heutigen Kenntnisse der geographischen Verbreitung der malayischen Pflanzen in den Philippinen sprechen dafür, dass eine ältere ausgeprägte Landverbindung zwischen den Philippinen und den Sunda-Inseln über Borneo bestanden hat, über welche eine starke Wanderung der typisch westmalayischen Formen nach den Philippinen stattfand. Sodann existierten spätere Verbindungen zwischen den Philippinen und den im Süden und Südosten gelegenen Inseln, welche einen Austausch in diesen Regionen gestatteten, und in deren Periode unzweifelhaft die ausgeprägten Celebes-, Molukken- und Papua-Elemente die Philippinen erreichten. In bezug auf Formosa ist hervorzuheben, dass [604] nahezu keine der typisch australischen Formen, die in der Philippinen-Flora vertreten sind, sowie keine der typischen Celebes-, Molukken- und Papua-Formen bis Formosa vordrangen.

Diese Tatsache deutet auf eine sehr frühzeitige und anhaltende geologische Trennung zwischen Formosa und Luzon, da die Verbindungen zwischen den Philippinen und den im Süden und Südosten gelegenen Inseln wahrscheinlich im Pliocän und Pleistocän bestanden. Dass die Trennung zwischen Luzon und Formosa früher eingetreten war, als in der Pliocänzeit, ist aus der Abwesenheit der *Dipterocarpaceae* zu schliessen, denn die geologischen Nachweise zeigen, dass in der Pliocänperiode Repräsentanten dieser Familie existierten und anscheinend dominante Faktoren in der Luzon-Flora waren. Es sind natürlich ausgeprägte malayische Typen in der Formosa-Flora vorhanden. Aber es ist wahrscheinlicher, dass diese malayischen Typen Formosa hauptsächlich über Indochina und Südchina erreichten, zu einer Zeit, als Formosa noch ein Teil des asiatischen Kontinents war; und dies war tatsächlich der Fall während der Pleistocänperiode.

Die oben erwähnten botanischen Spezialverwandtschaften zwischen Formosa und den Philippinen sind sehr schwach, während die Formosa-Flora so viele (265) charakteristische Gattungen einschliesst, die keinerlei Repräsentanten in den Philippinen besitzen. Die Philippinen-Flora andererseits enthält nicht weniger als 660 Gattungen, die nicht auf Formosa vorkommen. Aus diesem Grunde wäre es irrig und nicht den Tatsachen entsprechend, diese beiden Gebiete in eine botanische Provinz zu vereinigen. Formosa sollte wahrscheinlich eine eigene botanische Provinz bilden oder sollte zur Hinterindisch-ostasiatischen Provinz gezogen werden, die die Insel Hainan und das südöstliche China einschliesst.

— VI —

AN APPEAL FOR SIMPLIFIED LITERATURE CITATIONS*

[149] The average editor and the average publisher of scientific literature is ultra-conservative with respect to the form of reference citations, whether these be in terminal bibliographies, footnotes or text references to places of publication of technical names. This same statement may also apply equally well to the average author of scientific papers; although usually the author has no choice, being obliged to follow established usages no matter how antiquated and cumbersome these may be, in order to conform to editorial mandates. Forms adopted many years ago are currently followed and in many cases little or no attention is given to utility or to simplification. In some scientific periodicals, the use of the cumbersome Roman numerals for indicating volume numbers has been abandoned, but in a very high percentage of modern periodicals including a number of recently established ones, this ancient form is still used. It may be doubted if editors, publishers or authors give much attention to these seemingly small details, being more apt to follow the line of least resistance and past or current usage.

The conciseness, clearness and utility of indicating the volume number by black-faced figures **38** as compared with the Roman characters XXXVIII is manifest. With the use of the black-faced figures it is not necessary to stop to translate, as is frequently the case when the cumbersome Roman system is used. We are all more or less familiar with the lower numbers in the Roman series from long usage, but few can rapidly translate the more complicated higher figures. In this age of rapid publication shall we go to the extreme, when called upon to cite such a publication as Bulletin **1348** of the U. S. Depart-[2]ment of Agriculture by translating the simple figures into the cumbersome MCCCXLVIII? In a larger number of modern serial publications this absurd procedure becomes necessary because of usage and established editorial custom and is pedantic in the extreme.

There is little uniformity in scientific literature in reference to the form of citation. It not infrequently happens that an author in preparing a paper for submission to a certain journal follows the form approved for that serial, but if he changes his mind and later desires to submit the paper to some other serial, he frequently has to rewrite considerable parts of the manuscript in order to bring it into conformity with the style followed in the second one. This is especially true if the paper happens to be a taxonomic one with numerous literature citations or one with an extensive bibliography.

In several modern standard review publications the conciseness and utility of the simplified form of citation has been amply demonstrated, but editorial usage in review publications has had little or no influence on the forms used in established technical periodicals, while the editorial staffs of newly established serials frequently give no consideration to the

* E. D. Merrill, "An Appeal for Simplified Literature Citations" (Science II, 62:419-420, November 6, 1925).

matter. We are all familiar with review literature, but most of us are impervious to the manifest advantages of the simplified citation forms adopted by the majority of them. The simplified form adopted by several standard review publications is given below:

Chemical Abstracts: **24,** 57-70 (1925).
Science Abstracts: (—**24.** pp. 57-70, Feb., 1925).
Botanisches Centralblatt: 1925, **24,** 57-70.
Botanical Abstracts: **24**: 57-70. 1925.

In order to indicate the wide range of variation in reference citation, even where the Roman system of indicating volume numbers is not used, the fol-[3]lowing data have been compiled from the same reference in four different periodicals: [420]

	Number of Characters
(1) *Experiment Station Record:* (Ann. Appl. Biol., 24 (1923), No. 2, pp. 151-193, pls. 3, figs. 31).	56
(2) *Journal of Agricultural Research: In* Ann. Appl. Biol. v. 24, 1923, p. 151-193, pl. 1-3, fig. 1-31.	52
(3) *Philippine Journal of Science:* Ann. Appl. Biol. **24** (1923) 151-193, *pl. 1-3, fig. 1-31.*	45
(4) *Botanical Abstracts: Ann. Appl. Biol.* **24**: 151-193. *3 pl. 31 fig.* 1923 [or *pl. 1-3, fig. 1-31.* 1923].	40-46

In No. 1, with 56 characters, no data except the irrelevant "No. 2" are given that are not included in the shortest form utilizing but 40 characters. Two pairs of parentheses, "No. 2," "pp." and several commas are redundant. There is no differentiation in type; that is, nothing to catch the eye.

In No. 2, with 52 characters, the following are redundant: "In," "p," "v" and several commas. There is no differentiation in type.

In No. 3, with 45 characters, the parenthesis is redundant, owing to the place of the date of publication. There is, however, proper differentiation of type as to volume, plates and figures.

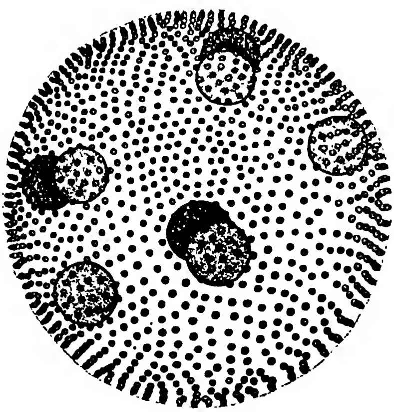
In No. 4, with 40 characters in its simplest form, there are no redundant letters, figures or punctuation marks, the later being reduced to a single colon and several periods. The volume number, page, plate and figure references are properly differentiated. Nothing essential is left out. It is the easiest to read and to proof read; the easiest to write, whether long hand or on the typewriter; and what is still more important presents a minimum chance of error. These points are perhaps matters of slight importance in short papers having only a few references but become of very great importance in those works having hundreds and even thousands of references.

There is little force in the argument that type of different styles such as black face, Roman and italics should be avoided in the same line. Most modern composition work is done on the linotype or monotype machine and with these machines the use of different fonts is practically as simple from the standpoint of the compositor as it is for a copyist to operate the shift key on a typewriter for upper case characters.

Merely because an established form of citation has been followed for many years is no reason why a change should not be made, especially if the change still makes the reference entirely clear and eliminates useless characters. Utility, simplicity, clarity and brevity should be the criteria,

not past or current custom. The general adoption of the concise form utilized in *Botanical Abstracts* by publishers, by responsible editors of technical literature and by authors of technical papers is greatly to be desired.

This appeal for the simplified form of citation is primarily directed to publishers, editors and members of editorial staffs. Unless the initiative be taken by these, the individual author is powerless in the matter. Scientists are frequently accused of not being practical, but here is an opportunity of demonstrating on a small scale a distinctly time-saving device that would in the long run make our published data simpler, clearer and more attractive. I venture the prediction that no author who has once prepared a paper in which the simplified form of citation herein discussed is used will voluntarily revert to the more ancient complicated forms that still prevail in the majority of our technical publications, whether these be in serial form or individual volumes.



— VII —

CORRELATION OF THE INDICATED BIOLOGIC ALLIANCES OF THE PHILIPPINES WITH THE GEOLOGIC HISTORY OF MALAYSIA*

[127] In interpreting probable previous land connections on the basis of the present known distribution of plants and animals, it is difficult to assign definite values to special groups. We merely know that mammals generally do not swim across broad separating seas; true fresh-water fishes, such as the cyprinoids, are also thus strictly limited; batrachians, while adapted to terrestrial life, are primarily adapted to fresh-water marsh conditions and cannot live in salt water in any stage of development; lizards and snakes are apparently better adapted to fortuitous distribution from one island to another by drift than are the batrachians or the mammals as a group; birds, bats, and most insects have, of course, the advantage of flight, yet many groups of birds and insects, and the bats especially, are curiously limited in their distribution, indicating that many do not migrate except over continuous land areas.

What is true of the inhibitions affecting the migrations of animals over insular areas is also true of plants. A number of species adapted to growth on the strand or in brackish water have special adaptations for dissemination of their fruits or seeds through the medium of ocean currents. Other species are [128] clearly adapted for dissemination by the wind. Still others are definitely adapted for dissemination through the medium of migratory birds; and very many have been distributed by man. In fact, man as an agent for the dissemination of plants and animals is and long has been an important factor— a much more important factor than he is usually credited with being. In countries like the Philippines, however, a high percentage of all species growing in the primary forests have no manifest adaptations for dissemination, yet a number of characteristic species occurring in the Philippines are widely distributed outside of the Archipelago, or are species manifestly closely allied to others of the same genera occurring elsewhere, thus clearly indicating a common origin. To account for the presence of such types in the Philippines it is absolutely essential to postulate previously existing land connections with different parts of Malaysia, over which such species or their ancestors could migrate.

Each specialist is, of course, interested in his own group, and it is but natural that he should be influenced in his deductions by his own special knowledge and his own special interests. Frequently, too, the specialist has definite knowledge of the geographic distribution only of the particular group with which he is familiar.

Schlechter,[1] for instance, from his intensive knowledge of the Orchidaceae

* Excerpts from E. D. Merrill's, "An Enumeration of Philippine Flowering Plants" 4:127-154, 1926 (Manila).

[1] Schlechter, R. Zur Kenntniss der Orchidaceen von Celebes, Fedde Repert. 10 (1911) 1-40; 66-96; 177-213.

of Malaysia has concluded that Celebes, or at least the northern part of that island, should in a wider sense be included in the Papuasian floristic region, as a separation of the Moluccas and Celebes from New Guinea on the basis of the orchid flora is neither fixed nor possible. Is it, however, safe, to draw conclusions on the basis of the geographic distribution of the species of one family only?

I have definitely shown[2] that in the Dipterocarpaceae, whose great trees are dominant in the primary forests of the Philippines, there is an overwhelming relationship with the flora of the Sunda Islands or western Malaysia.

We find this essentially Indo-Malaysian family, comprising about seventeen genera and about three hundred seventy-seven [129] known species, to be most highly developed in Borneo, with eleven genera and slightly over one hundred species; or in the Sunda Islands, with eleven genera and one hundred forty-four species. The Eastern Peninsula is the next richest area, with eleven genera and one hundred thirty-five species; and the Philippines third, with nine genera and about fifty species. Sumatra will doubtless be found to be at least as rich in genera and in species as are Borneo and the neighboring parts of the Malay Peninsula. No representative reaches Formosa, although five genera, one species in each, reach the Babuyan Islands north of Luzon. The family is represented in India and well represented in Ceylon. There is one species in the Seychelles and one small anomalous genus in tropical Africa. The family has no representative in the American Tropics, nor in Australia or Polynesia, being essentially Indo-Malaysian.

In contrast to the rich dipterocarp flora in western Malaysia and in the Philippines we find in the entire region from Celebes to New Guinea but fourteen recorded species in four genera, as follows: *Anisoptera* with four species out of a total of twenty-one; *Hopea* with three species out of a total of fifty-six; *Shorea* with three species out of a total of more than one hundred; and *Vatica* with four species out of a total of about fifty, a grand total of fourteen species in the four genera having the approximate geographic distribution of the entire family. If a continental area had existed over what is now the entire Malaysian region at the time the Dipterocarpaceae was attaining its geographic distribution, we would expect to find the genera and species as numerous and as dominant in southeastern Malaysia as they are in western Malaysia and in the Philippines, for the climatic conditions in eastern Malaysia are practically identical with those of western Malaysia.

Diels[3] states that the Dipterocarpaceae play an unimportant rôle in New Guinea and considers that there is no reason to believe that future investigations will greatly increase the known number of species. He makes the significant statement that the species that are sufficiently well known to allow of definite systematization stand in close relationship with those of

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[2] **Merrill, E. D.** Distribution of the Dipterocarpaceae: origin and relationships of the Philippine flora and causes of the differences between the floras of eastern and western Malaysia, Philip. Journ. Sci. 23 (1923) 1-33, *t. 1-8.*

[3] **Diels, L.** Die Dipterocarpaceen von Papuasien, Engl. Bot. Jahrb. 57 (1922) 460-463.

Celebes and the Philippines and concludes that this family represents a younger element in the New Guinea flora that has [130] been received from the northwest by way of Celebes and the Philippines.

In contrast to the manifestly western Malaysian alliances of the Philippine Dipterocarpaceae the characteristic and manifestly older family Myrtaceae shows equally strong special alliances with the islands south and southeast of the Philippines, or eastern Malaysia, and no special alliances with western Malaysia. Thus, *Mooria* (*Cloëzia*) is confined to Mindanao and New Caledonia, with one species in the former island and several in the latter; *Eucalyptus* has one indigenous species in Mindanao, which is dominant in favorable localities, and the same species occurs in Celebes, the Moluccas, New Guinea, and the Bismarck Archipelago, being one of the very few representatives of this large genus known from outside of Australia; *Mearnsia* has one species in Mindoro and Mindanao, one in New Guinea, and one in New Caledonia; *Osbornia* is a monotypic genus known from northern Australia, the Philippines, and eastern Borneo; *Xanthostemon* presents three species in the Philippines, one in Celebes, one or two in New Guinea, a few in Australia, and a considerable number in New Caledonia. Two other genera that may be considered as Australian types, *Leptospermum* and *Tristania*, are represented in the Philippines, but both are of general distribution all over the Malaysian region; while *Melaleuca* and *Baeckea* both occur in western Malaysia but are absent from the Philippines.

It is perfectly evident that different groups of plants and animals have originated and become dominant at different periods of geologic history. The discrepancies between the relationships of the Philippine flora as shown by the Dipterocarpaceae and Myrtaceae are explainable by reference to the geologic history of Malaysia. It is apparent that the Myrtaceae is the older group and that some of our southeastern representatives possibly reached the Philippines before continental connections were broken between Asia and Australia; that is, in the late Cretaceous or in the ep-Mesozoic interval; or if they came into the Philippines later, from New Guinea as a center, they came when land connections existed between the Philippines and the islands to the south and southeast, but after direct connections between eastern and western Malaysia had been broken. The Dipterocarpaceae originated later, probably in southern Asia and what is now the Sunda Islands, and extended into the Philippines when land connections existed between Borneo and the Philippines, but after direct land connections between [131] New Guinea and the Sunda Islands had been broken. It is possible that this family originated in the early Tertiary, although it possibly dates from the late Tertiary (Neogene); the geologic records show that the family was well represented in Luzon and was apparently dominant here in the Pliocene. However, the family apparently did not attain dominance anywhere until the late Tertiary—too late for it to attain a world-wide geographic distribution, and the family was largely confined to the region in which it originated, tropical Asia and Malaysia, and in Malaysia chiefly in the western part and the Philippines. Interrupting arms of the sea prevented many dipterocarp types from reaching eastern Malaysia.

Therefore, I consider the distribution of any one family of plants or

any one group of animals to be an unsafe guide to follow in drawing general conclusions as to biogeographic relationships, a point that has been emphasized by Andrews[4] in reference to the Australian flora.

General conclusions should be based on a study of the geographic distribution of all groups of plants and animals taken in connection with the geologic and geographic history of the regions under discussion. Schlechter is doubtless correct in his conclusions as to the alliances of the Celebes and Papuan orchid flora, as he found that the greater part of the orchid species of Celebes showed a remarkable affinity with Papuan ones, although there were scattered unmistakable relations to Philippine forms; but may not these orchidaceous Celebesian-Philippine alliances be merely the northern extension of Papuan types which have been able to travel the longer distance into the Philippines, as has been the case with Papuan types in many other families of plants, as well as in various groups of animals? The fact must not be overlooked that outside of the Orchidaceae there are many genera and species that are known only from Celebes and the Philippines and an equally remarkable series confined to the Philippines and the Moluccas, New Guinea, and even New Caledonia, to say nothing of Australia. It would seem then that, granting that the Celebes flora should be classed as Papuasian, the island has served as a transmission region, allowing numerous Papuasian and other eastern Malaysian types to reach the Philippines, and doubtless at the same time permitting various western Malaysian types to reach eastern Malaysia via the Philippines. It is, of course, perfectly evident that [132] intermigrations would take place, for it would be illogical to assume that migrations of plants and animals in an insular region like that under discussion would be all in the same direction.

From the foregoing discussions of the floristic and faunistic relationships of the Philippines with surrounding regions several striking facts are evident. There are manifestly Asiatic types of plants and, to a lesser degree, animals, especially in northern Luzon, that are unknown from Malaysia proper. The flora and fauna, as a whole, is, however, overwhelmingly Malaysian, presenting definite and unmistakable alliances with both eastern and western Malaysia. At the same time, we find in the Philippines a striking series of Australian types, more numerous in both genera and species, and definitely stronger than are the similar elements in western Malaysia. An explanation of these specific alliances is to be found in the geologic history, fragmentary as our knowledge of this is, of Malaysia as a whole.

The Asiatic elements in the Archipelago, especially those in northern Luzon, are probably to be explained on the basis of previous land connections with southeastern Asia and Formosa, but these connections were ancient. The Formosan rift, extending through the Bashi Channel between Formosa and the Batan Islands, was apparently established in the early Tertiary and since that time there has been no land connection between the Philippines and Formosa, or direct connection between the Philippines and southern Asia. This conclusion is supported by the fact that not one of the numerous eastern Malaysian types of plants in the Philippines extends to

[4] **Andrews, E. C. The geological history of the Australian flowering plants, Am. Journ. Sci. 42 (1916) 172.**

Formosa, and furthermore by the almost complete lack of special alliances between the fauna and the flora of Formosa and those of the Philippines, or between those of southeastern Asia and the Philippines. It would seem that in the early Tertiary there was a migration of Asiatic types into Malaysia via the Philippines, but this migration was a weaker one than that following the route via the Malay Peninsula and Sumatra, a route that remained open to the close of the Pleistocene. No further discussion of these ancient Asiatic-Philippine connections seems to be called for here.

With Malaysia as a whole, however, the Philippine connections have been very much more pronounced, and of very much greater duration, extending, with certain interruptions, from the late Mesozoic to the end of the Pleistocene, or in some respects possibly into the Recent.

[133] It seems to be perfectly clear that in the Cretaceous the Philippines or parts of what is now the Philippines formed a part of the great continent extending from Asia to Australia and included all of Malaysia. The eastern boundary of the present Philippine Archipelago probably marked the approximate eastern boundary of this ancient Cretaceous continent. At this period, as noted by Chamberlin and Salisbury,[5] the angiosperms were in marked dominance, and during this period genera now living became more and more abundant, giving the whole flora a distinctly modern aspect. The same authors[6] further note that in plant history the succeeding Eocene was not "the dawn of the recent," for the great change from the medieval to the modern, in its main essentials, had taken place in the early Cretaceous. In the development of modern floras, the Eocene was not even a period of any radical innovation.

It has been noted that in Mesozoic times there was some land mass representing what is now the Philippines, and that during the Cretaceous what is now the Philippine Archipelago was a great land mass above the sea. It seems safe to assume that this land mass was a part of the great Asiatic-Australian continent and that its vegetation was in general similar to that of other parts of Malaysia of that period, although no Philippine Cretaceous plant remains are known. The same general conditions probably extended through the Eocene.

Geologists are in agreement that the Cretaceous was a period of remarkable climatic uniformity, in which strictly tropical types of vegetation existed far to the north and to the south. These equable climatic conditions permitted a rapid and wide distribution of the flora in both hemispheres. It is highly probable that some types of plants have persisted in the Philippines since they attained this distribution in the late Cretaceous, at least so far as generic types are concerned. We may thus explain the wide distribution of families and genera in what is now tropical Asia, Malaysia, and Australia, in that they attained their distribution, so far as they were then developed, before the ancient Asiatic-Australian continent was broken up, being able to travel over continuous land areas.

The break between Australia and Asia came in the late Cretaceous or in the ep-Mesozoic interval and it seems to be evident that, since that time, all intermigrations of plants and animals [134] between Australia and Asia

[5] **Chamberlin, T. C., and R. D. Salisbury, Geology 3 (1907) 173.**
[6] Op. cit. 226.

and between eastern and western Malaysia have been interrupted or inhibited by the constant archipelagic condition of some parts of Malaysia. This brief résumé of early geologic history clears the way for a more detailed discussion of the eastern and western Malaysian question, the causes for the manifest differences between the faunas and floras of the two regions, and the intermediate position the Philippine Archipelago holds in reference to both eastern and western Malaysia.

In a recently published paper[7] a detailed discussion is given in reference to the geologic history of the Dipterocarpaceae, the geographic distribution of the family and its significance, as well as an attempt to explain the fundamental causes for the different biologic aspects of eastern and western Malaysia. Briefly, it is shown that this family of great trees, which dominate the primary forests of parts of India, Ceylon, the Eastern Peninsula, western Malaysia, and the Philippines, is very weakly developed in eastern Malaysia; that geologically speaking the family is not an ancient one; that the various species are essentially adapted to humidity, light, and temperature conditions of the low-altitude Indo-Malaysian primary forests; that generally speaking the fruits are adapted to neither wind nor water dissemination; and that the various genera must have attained their present distribution over continuous land connections and at a time when continuous primary forests already existed. Much of the following discussion is based on this paper.

Molengraaff[8] has concisely summarized the present knowledge of the distribution of land and sea areas in the Malaysian region, based on the latest available geologic and hydrographic data. His very definite conclusions cannot be ignored by any student of the distribution of the flora and the fauna in this region. From the data so ably presented by him and summarized below it is perfectly evident why we find the striking differences between the floras and the faunas of eastern and western Malaysia, and his conclusions have a direct bearing on [135] any explanation of the origin of the Philippine fauna and flora that can be offered.

He discusses briefly the presence of the two continental shelves in the Asiatic-Australian region and their significance, and the intervening Australasian mediterranean sea between Asia and Australia and its significance.

The two great shelves are attached to the continents of Asia and Australia—the Asiatic bank, or Sunda shelf, and the Australian bank, or Sahul shelf. The Sunda shelf is the greatest one in the world, comprising approximately 1,850,000 square kilometers and carrying upon it the greater Sunda Islands, Sumatra, Java, and Borneo, and the numerous smaller islands as far east as Bali. The Sahul shelf carries upon it New Guinea. The surfaces of both shelves are almost perfectly even, while the average depth of the water is but about 60 meters. Both shelf regions have been stable at least since the close of the Pleistocene, but there have been changes in water level which are readily explained by the falling of the sea level in

[7] **Merrill, E. D.** Distribution of the Dipterocarpaceae. Origin and relationships of the Philippine flora and causes of the differences between the floras of eastern and western Malaysia, Philip. Journ. Sci. 23 (1923) 1-33, *t. 1-8*.

[8] **Molengraaff, G. A. F.** Modern deep-sea research in the East Indian Archipelago, Geogr. Journ. 57 (1921) 95-121, *fig. 1-9, map*.

consequence of the growth of the Pleistocene ice caps. During the Pleistocene ice ages New Guinea was a part of the Australian continent, and the Sunda Islands, Sumatra, Java, and Borneo were united with southern Asia. An elevation of 45 meters to-day would connect the greater Sunda Islands with Asia, while an elevation of 20 meters would unite New Guinea with Australia.

Interposed between these two stable continental areas is an intermediate area, radically different in its present physical features and in its geologic history. This intermediate area is one of inclosed deep-sea basins, and is still unstable and orogenetically active, as it has been during the preceding geologic periods. The striking features are the well-marked troughlike shape of the majority of the deep-sea basins; their great depths, varying from 1,200 to 6,000 meters; the elongated form of most of the islands bordering these basins, their elongation being parallel to the troughs, these islands usually presenting very considerable altitudes; the arrangement of both basins and islands in curved rows; and the conspicuous signs of elevation in modern times. Of the twenty-seven deep-sea basins in the entire Malaysian Archipelago four only are found in the western part—that is, associated with the Malay Peninsula, Sumatra, and Java—and these are west and south of the large land masses. The other twenty-three basins are all associated with the eastern part of the Archipelago, two between the [136] northern end of Borneo and China, the remainder all east of Borneo and Bali. That is, these deep, inclosed troughlike seas are essentially characteristic of the entire group of islands from the Macassar Strait and Lombok Passage to eastern New Guinea and northward including the Philippines.

As Molengraaff states, it is reasonable to surmise that a genetic connection must exist between the subsidence of the trough-shaped deep-sea basins and the elevation of the adjoining elongated islands, their common origin to be sought in the same crustal movement; that is, a process of folding at a certain depth. We have then a large unstable stress area between two even larger stable areas.

Molengraaff's general conclusions of interest in connection with the present subject are as follows:

1. The Australasian mediterranean sea consists of two strongly contrasted areas, one with an exceptionally uniform and undisturbed submarine topography, and another with an extremely complicated topography.

2. The first area is that of the great shelves, which are attached to the continents of Asia and Australia; the other that of the enclosed deep sea basins.

3. The area of the shelf seas has been stable and has not been affected by diastrophism, at least since the end of the Pliocene Age. The area to which the deep-sea basins belong has since that time continued to be unstable as it was before and has been, and is still, the seat of powerful orogenetic movements.

4. The shelf seas owe their origin to the submersion of a strongly peneplainized land surface caused by a rise of the sea-level of at least 40 fathoms, consequent on the melting of the ice-caps at and after the close of the Pleistocene Ice Age.

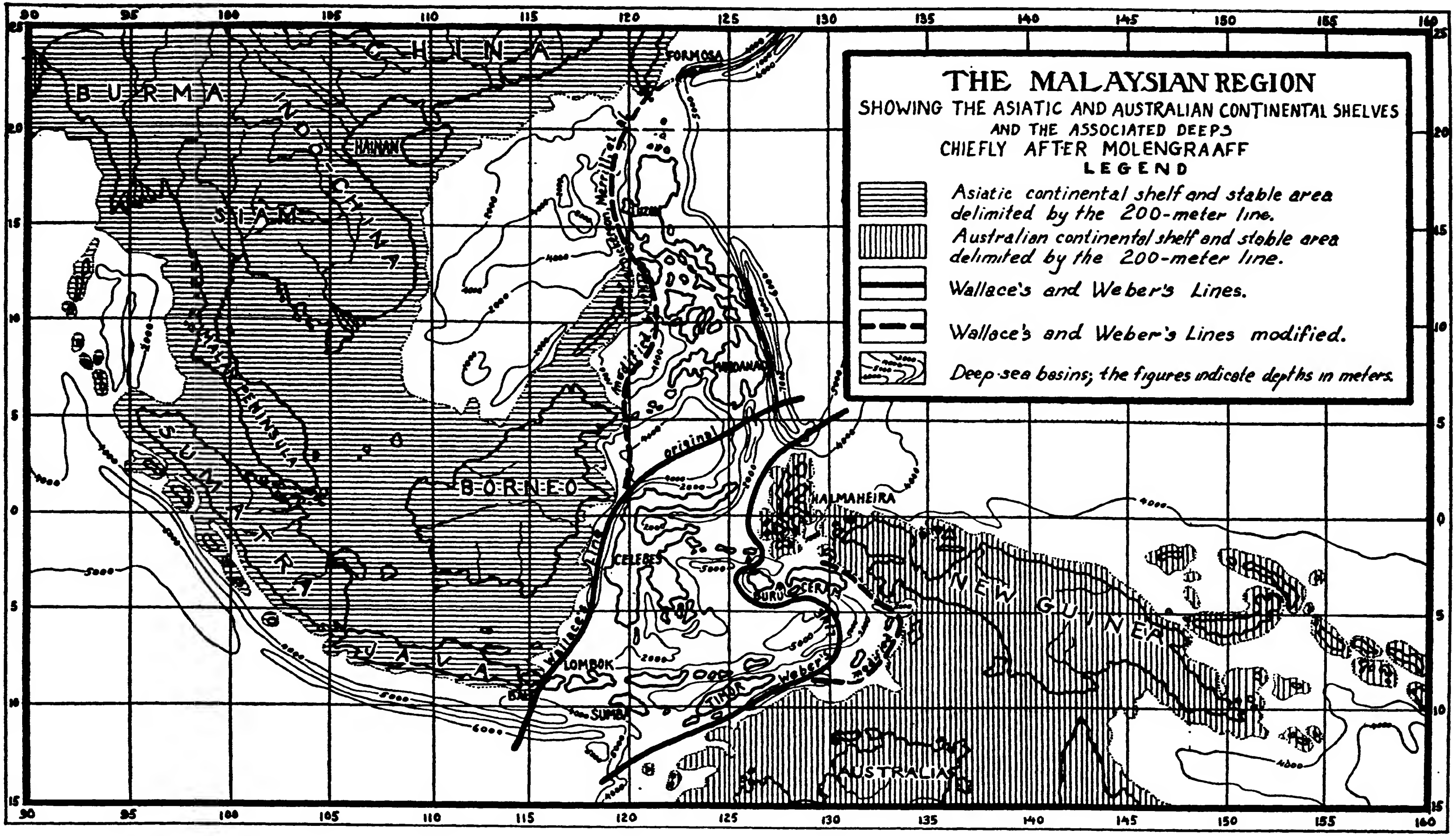
5. The deep-sea basins and the adjoining elevated islands are simultaneously formed, and continue to be developed by a process of folding at a certain depth.

The geologic history of Sundaland from the end of the Pliocene through the Pleistocene is outlined by Molengraaff as follows: At the end of the Pliocene or the beginning of the Pleistocene the present Sunda Sea

probably consisted of low land or a group of islands. At the beginning of the ice age the sea level sank and stood at least 40 fathoms lower than at the present day. The great land area resulting united Sumatra, Borneo, and Java with southern Asia.

During the Pleistocene a period of long-continued and active erosion followed. At the end of the glacial period the sea level rose again to its present height, consequent on the melting of the ice caps. The Sunda peneplain was gradually submerged, and for the greater part was covered by the sea as it is to-day. [137] There was, however, not one but a succession of colder glacial periods alternating with warmer interglacial ones. Consequently, with the alternate withdrawal and release of the water as the ice caps formed and melted, the Sunda peneplain has been alternately above and below sea level, and insular and continental conditions have likewise alternated as a result. This theoretical history of Sundaland is borne out by its present geology and geography. The evidences of recent subsidences, or a corresponding rise in sea level, are found all along the coast of the Sunda Sea; no traces of modern elevations of importance are found; the land to a great distance from the coast is flat and the even surface of the shelf is prolonged without change of character far into the interior of the low country surrounding most of the Sunda Sea; deltas are generally wanting, although the Sumatran and Bornean rivers transport heavy loads of sediment; and in general coast lines are embayed and the rivers possess wide funnel-shaped mouths with great depths in their lower courses; that is, the lower parts of the streams are drowned rivers, which in many instances can be traced far out into the sea.

In Pleistocene time a divide extended across the Sunda Sea from Sumatra via Bangka, Billiton, and the Karimata group to Borneo, the drainage of the northern slopes being into the China Sea, that of the southern slopes into the southern part of Macassar Strait. The various rivers of the east coast of Sumatra and of northern and western Borneo discharging into the Sunda Sea are the dismembered branches of this previously existing very large river. Thus the Musi and the Kapuas, one in Sumatra, the other in Borneo, and both large streams, were confluents of the northern main stream flowing into the China Sea. Weber, quoted by Molengraaff, thus explains certain remarkable facts in reference to the present distribution of fresh-water fishes in Malaysia. The fish fauna of the Musi in eastern Sumatra is strikingly similar to that of the Kapuas in western Borneo, though these two rivers are now separated by a wide expanse of sea. In striking contrast to these faunistically very closely allied streams of Sumatra and Borneo are the Kapuas in western Borneo and the Kutei of eastern Borneo; these two streams, notwithstanding the fact that both take their rise in the same divide, show very striking differences in their faunas. The great river system that in Pleistocene times flowed to the northeast and emptied into the China Sea took the drainage of the eastern slopes of Sumatra, at least a part of that of the Malay Peninsula, [138] perhaps some of that of Siam and Indo-China, and certainly most of that of northern and western Borneo. On the other hand, the rivers of the southern end of Sumatra, of southern Borneo, and of northern Java probably were parts



THE MALAYSIAN REGION
SHOWING THE ASIATIC AND AUSTRALIAN CONTINENTAL SHELVES
AND THE ASSOCIATED DEEPS
CHIEFLY AFTER MOLENGRAAFF
LEGEND
Asiatic continental shelf and stable area delimited by the 200-meter line.
Australian continental shelf and stable area delimited by the 200-meter line.
Wallace's and Weber's Lines.
Wallace's and Weber's Lines modified.
Deep-sea basins; the figures indicate depths in meters.
BURMA
CHINA
FORMOSA
HAINAN
INDO-CHINA
SIAM
MALAY PENINSULA
SUMATRA
BORNEO
JAVA
CELEBES
HALMAHEIRA
NEW GUINEA
AUSTRALIA
LOMBOK
BALI
SUMBA
TIMOR
BURU
CERAM
MINDANAO

of another great drainage system flowing westerly and emptying into the southern part of Macassar Strait.

Molengraaff cites as final proof of the great submersion of the region, the great barrier reef that marks the east coast of the submerged Sundaland which evidently originated from a fringing reef of late Pleistocene time. This barrier reef was not recognized as such until Niermeyer[9] called attention to it, the reasons being the exceptionally great distance from the coast to which it belongs and previous insufficient knowledge of the depths in Macassar Strait.

From Sundaland a narrow northeastern projection of the Asiatic continental shelf carries upon it Balabac, Palawan, the Calamian Islands, and some smaller islands and extends to the vicinity of Mindoro. Likewise, Mindanao is connected with Borneo by means of the now drowned Sulu Isthmus, this forming the Sulu Archipelago. Mindanao was manifestly connected with the drowned island Celebes by a similar isthmus marked by the Sangi Islands, while eastern Mindanao was apparently connected through the Talaur Islands with the drowned island Gilolo and its neighbors Ternate and Tidore, as well as with New Guinea. It is generally agreed among geologists that there has been no direct land connection between Borneo and Celebes later than the early Tertiary, see p. 228 [142].

In connection with Molengraaff's conclusions attention is called to Brouwer's[10] important contributions from the standpoint of earthquakes in relation to the geologic structure and the tectonic features of Malaysia. Figure 3 [not reproduced], showing the tectonic features of the region, is adapted from Brouwer with the addition of Philippine data supplied by Dickerson, while fig. 2 [p. 226] showing the stable and unstable regions of Malaysia, is after Brouwer. These two figures should be compared with [the map on p. 224] showing the positions of Wallace's and Weber's Lines.

[139] Geologic evidence is strong that within the Tertiary there were land connections between the Philippines and the islands to the south and southeast, but the evidence from all sources does not seem to indicate that the connections to the south or those with Borneo were more than narrow isthmuses. The botanical evidence is that the Bornean connections were earlier and were either more pronounced or longer continued than the Celebes-Moluccan.

It is evident that there have been at times various other connections between what are now separate islands in the group south and southeast of the Philippines. It is likewise very evi-[140]dent that what are now individual islands in the Philippines were formerly separated into several, and also that what are now separate islands were united into one. Thus, Mindanao in the Pleistocene was separated into at least four, perhaps five,

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[9] **Niermeyer, J. F.** Barriere-riffen en atollen in de Oost-Indische Archipel, Tijdschr. Kon. Nederl. Aardr. Gen. **28** (1911) 880, quoted by Molengraaff.

[10] **Brouwer, H. A.** Some relations of earthquakes to geologic structure in the East Indian Archipelago, Bull. Seismol. Soc. Am. **11** (1921) 166-182, *fig. 1-7;* The major tectonic features of the Dutch East Indies, Journ. Wash. Acad. Sci. **12** (1922) 173-185, *fig. 1.*

distinct islands, the uplift taking place in late Pleistocene or post-Pleistocene time; the Zambales region in Luzon was manifestly an island separated from Luzon; Cebu was several small separate islands. Samar and Leyte were manifestly connected. San Bernardino Strait, between Samar and Luzon, has not been permanent, but at times these two islands have been united. Marinduque was certainly united with Luzon. Panay and Negros have been at times united with Masbate. Many of these changes took place as late as the Pliocene or Pleistocene, or some even in the Recent.

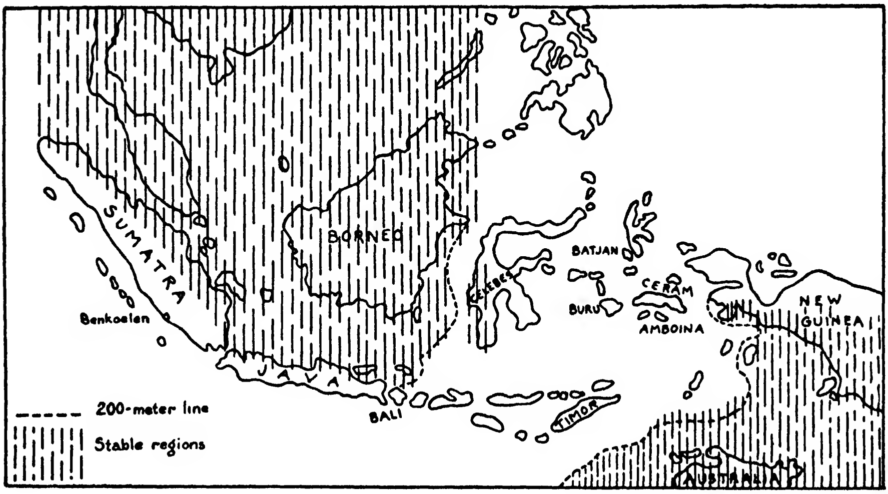

FIG. 2. — Schematic representation of the stable and unstable regions in the East Indian Archipelago.

With this geologic history in mind it becomes very evident why we find the Asiatic types of plants and animals rapidly dwindling in numbers in the islands east of Macassar Strait, with a corresponding but even more rapid decrease of Australian types as we go westward from New Guinea, and their almost entire absence from the Sunda Islands. The entire region from Celebes to New Guinea is a transition area in which Australian and Asiatic types have mingled, but the persistent archipelagic nature of the entire region from Macassar Strait to New Guinea has prevented general intermigration of these Australian and Asiatic types. Hence, eastward of Macassar Strait there is a very rapid dwindling of Asiatic types, so rapid in certain groups as to be almost startling, as in the true freshwater fishes, from 212 in Sumatra, 292 in Borneo, and 131 in Java to only 4 in Celebes; the amphibians with the corresponding numbers 50, 78, 37, and 25; the mammals 115, 133, 68, and 39; and the reptiles 175, 191, 129, and 87,[11] with fewer and fewer in each group as we go eastward from Celebes to New Guinea. In the animal kingdom a few Australian types reach Macassar Strait, while in the plant kingdom a few types extend west of it.

[11] These are Van Kampen's figures of 1909.

These side lights on Malaysian geologic history are significant in reference to the general problem of the biogeographic boundaries in Malaysia that have been proposed by various authors, especially since Wallace's Line was so denominated by Huxley, based on Wallace's observations that Macassar Strait [141] and Lombok Passage form a striking line of demarcation between the faunas of eastern and western Malaysia.

Wallace's Line was placed between Bali and Lombok, extending northward through Macassar Strait between Borneo and Celebes and thence, turning to the eastward between Celebes and Mindanao, extended into the Pacific Ocean. It was based on observations and published statements of Alfred Russell Wallace regarding the evident differences in the biology of eastern and western Malaysia. Critics of Wallace's Line have not always been entirely fair to Wallace. In his Island Life he clearly states that Celebes, although included by him in the Australian Region, from a balance of considerations, almost equally belongs to the Oriental Region, and that it consequently must be left out of account in the general sketch of the zoological features of the Australian Region. Again, he speaks of it as an "anomalous island," because both by what it has and by what it lacks it occupies such an exactly intermediate position between the Australian and Oriental Regions.

In reference to the position of Wallace's Line, our present data seem to show that this fundamental dividing line does not turn to the east between Celebes and Mindanao, but extends northward through Sibutu Passage, Sulu Sea, and Mindoro Strait between the Calamian group and Mindoro, thence northward and then eastward between Formosa and the Batan Islands into the Pacific. The extension of this line north of Macassar Strait, like its southward extension between Bali and Lombok, has not been of so long-continued and permanent a nature as Macassar Strait [see the map on p. 224].

There have been numerous critics of the validity of Wallace's Line, and several substitutes have been proposed, based on the geographic distribution of this or that group of organisms; perhaps the most notable is that proposed by Pelseneer[12] and denominated by him Weber's Line, but Weber's Line is untenable when the geographic distribution of all groups of organisms is considered, even as is Wallace's Line.

Weber's Line extends between Timor and Australia, then northward between Sermata and Babber Islands, thence curving slightly to the east, recurving to the west south of Buru, eastward again through the Pitt Passage north of Buru, then [142] northward through the Molucca Passage into the Pacific Ocean west of Obi, Ternate, and Halmahera (Gilolo). I am inclined to modify this somewhat, carrying it farther to the eastward south of Babber and Tenimber, and then northward between Kei and Aru, as well as north of Buru and Ceram, being influenced in this matter by the studies of Brouwer and Molengraaff. I am not certain whether Halmahera should be east or west of the line, for it may well prove to be the case that

[12] **Pelseneer, P.** La ligne de Weber, limite zoologique de l'Asie et de l'Australie, Bull. Acad. Roy. Belg. (1904) 1001-1022.

the line should be placed between Halmahera and New Guinea. The positions of both Wallace's and Weber's Lines, and suggested modifications, are shown in [the map on p. 224].

It is unnecessary here to give a detailed discussion of the different views as to where the line of demarcation between the Asiatic and the Australian faunas should be placed, as this question has been excellently reviewed by Pelseneer. The problem as stated by him resolved itself into establishing a simple line of demarcation between Asia and Australia, or in recognizing a region of transition between the two continents. Pelseneer favored the principle of a simple line rather than a transition region; but, in view of our present data, it is evident that no simple line can be drawn that applies to all groups. The idea of a transition region, first proposed by S. Müller in 1846 and supported by Heilprin, Von Martens, Flower and Lydekker, Kükenthal, Van Kampen, Barbour, and others in one form or another, seems to represent the situation correctly, and this transition region in which the Asiatic and Australian faunas and floras mingle, is practically delimited by Wallace's Line to the west, and by Weber's Line to the east.

The essential fact in reference to these two proposed biogeographic boundary lines is that both are apparently due to fundamental geologic conditions, both being ancient continental boundaries.

In reference to Borneo and Celebes the Sarasins[13] state that, as Celebes and Borneo do not present a single animal in common that is not found also in Java, Sumatra, or the Philippines, there is not the slightest possibility that a direct land bridge ever existed between Celebes and Borneo across Macassar Strait, since early Tertiary times. The significant part of this [143] statement is that Macassar Strait is geologically the oldest and by far the most important part of Wallace's Line. Macassar Strait has, then, been a continuous arm of the sea for a very long period and as such has been a very important limiting factor in the intermigrations of both plants and animals between eastern and western Malaysia. Migrations of western Malaysian types into Celebes have not been direct from its near neighbor, Borneo, but by the roundabout routes through Java and the Lesser Sunda Islands to the south and the Sulu Archipelago and Mindanao to the north. This explains, in a large degree, the anomalous fauna of Celebes, which puzzled Wallace, so far as its western types are concerned, and also explains the paucity of fresh-water fishes in Celebes as compared with their great abundance in Sundaland and their fair development in Mindanao.

In reference to Weber's Line it is significant that Molengraaff[14] states that the trough sea or series of trough seas consisting of the Timor Sea separating Timor from Australia, the Kei trough, the Ceram trough, and the Ceram Sea is an important geologic boundary, as it separates totally different structures from each other. He states that the nonvolcanic islands of this arc originated as oceanic ones by anticlinal folding and that, geologically, they stand in close relationship with eastern Asia but have no

[13] **Sarasin, P.** und **F.** Materialien zur Naturgeschichte der Insel Celebes, III. Ueber die geologische Geschichte der Insel Celebes auf Grund der Thierverbreitung (1901).

[14] **Molengraaff, G. A. F.** Geologie in: De Zeeën van Nederlandsch Oost-Indië (1921) *272-357, t. 1-7.*

connection at all with Australia. If we are to accept a geologic boundary between Australia and Asia, then the boundary must be drawn between Timor and Australia and between Ceram and New Guinea. This is approximately Weber's Line.

In past geologic times much of the area between southeastern Asia and Australia has been occupied by epeiric seas, at least since the Cretaceous. Dr. Roy E. Dickerson calls my attention to the facts that Java, Sumatra, and Borneo are in large part covered by marine Tertiary sediments and that New Guinea is also largely composed of similar sediments; the sediments in British New Guinea are largely Miocene. Java, Sumatra, and Borneo on the one hand, and New Guinea on the other hand, are land masses associated with shelf seas which have consequently during Tertiary times been alternately dry and flooded by shallow seas. Practically throughout the Tertiary New [144] Guinea, Celebes, Borneo, Java, and Sumatra have changed their patterns from epoch to epoch. During the Pleistocene Java, Sumatra, and Borneo were alternately connected and disconnected with the Asiatic mainland, and New Guinea was alternately connected and disconnected with Australia. Formosa has had the same history in reference to Asia. The great difference between the regions now delimited by the Asiatic and Australian continental shelves and the intermediate insular area is the presence of great development during Pleistocene times in the intermediate stress area of very notable marine deeps and corresponding upthrust island masses.

It would seem that the real significance of both Wallace's and Weber's Lines, as biogeographic boundaries, is due primarily to fundamental geologic conditions. Wallace's Line is merely the approximate western boundary of the unstable insular area, and Weber's Line is apparently the approximate eastern boundary of the same terrane and bears much the same relationship to New Guinea and Australia that Wallace's Line bears to Asia or, rather, the former eastern boundary of the Asiatic continent. The fact seems to be sufficiently well established that two ancient more or less stable continental areas, now delimited by the Asiatic and Australian continental shelves, existed in the region under discussion wherein both plants and ànimals migrated over continuous land areas. It seems also to be as thoroughly established that there has existed since Cretaceous times an intermediate insular area occupying the space between the ancient Asiatic and Australian continents, which at times, especially in the Pleistocene, has been markedly unstable. The western boundary of this unstable area where it impinges on the old Asiatic continent (the present Asiatic continental shelf) is Wallace's Line, and its eastern boundary, where it impinges on the old Australian continent (the present Australian continental shelf) is Weber's Line. Throughout the entire intermediate insular region, which included much of what is now the Philippines, intermigrations have been interrupted or inhibited by the prevailing archipelagic conditions.

Various biologists who have studied the subject are in agreement on the general proposition that the entire region from Lombok and Celebes to New Guinea is a transition one in which the Indian and Australian faunas and floras mingle, where from east to west Australian types diminish

rapidly, and where from west to east Asiatic types decrease with practically equal [145] rapidity. From a zoölogical standpoint the facts in reference to this transition area are clearly brought out by Weber[15] and by Van Kampen.[16]

Barbour[17] states the case thus:

> Neither Wallace's nor any other line can be held to form a real zoological boundary. A transition zone *with a fairly definite western frontier* [italics mine. E. D. M.] and with an eastern frontier incapable of equally clear definition seems really to be the condition which serves to separate the Malayan from the Papuasian subregions. This zone may be about equally well defined for any of the groups of land animals, and the boundaries for the distribution of the several groups coincide with reasonable accuracy.

The "fairly definite western boundary" is Wallace's Line, and I would merely add to Barbour's statement the fact that Weber's Line seems to form a fairly definite eastern boundary of this transition zone, perhaps comparable with Wallace's Line as its western boundary. Much work remains to be done, however, in reference to the relative values of the two proposed lines, but Wallace's Line cannot be abandoned in favor of Weber's Line or vice versa.

We have seen that in the Cretaceous a continuous continental area existed from Asia to Australia covering what is now Malaysia. This allowed the intermigration of the plants and animals of that time over the entire region. In the late Cretaceous the actual separation of Australia from Asia took place, and since that time archipelagic conditions have constantly existed in what is now Malaysia, or at least in certain parts, notably the eastern part, of this region.

Ancestral types having thus been generally disseminated, and geographically large tropical areas thus populated having become separated from each other and having remained separate since the early Tertiary, it is but natural to expect that secondary centers of origin and dispersal would have been established. In this connection it is only necessary to mention Australia, where [146] due to long isolation and the prevailing soil and climatic conditions, a remarkable, specialized vegetation has developed.[18]

In the tropical regions under discussion it seems to be evident that two secondary centers of origin and dispersal became established after the Australian region was separated from Asia. One of these is what has been called western Malaysia in this paper, which, although receiving constant accretions to its fauna and flora from Asia, has, at least in the plant kingdom, evolved a number of remarkable plant types; for this region we may well adopt Molengraaff's proposed name Sundaland. The other tropical

[15] **Weber, M.** Der Indo-australische Archipel und die Geschichte seiner Tierwelt (1902).

[16] **Van Kampen, P. N.** De Zoogeografie van den Indischen Archipel, Nat. Tijdschr. Nederl. Ind. (1909) Bijblad 3, 4; English translation, Am. Nat. 45 (1911) 537-560.

[17] **Barbour, T.** A contribution to the zoögeography of the East Indian Islands, Mem. Mus. Comp. Zool. Harvard Univ. 44 (1912) 1-203, *t. 1-8*.

[18] **Andrews, E. C.** The geological history of Australian flowering plants, Am. Journ. Sci. 42 (1916) 171-232.

region corresponding to Sundaland is New Guinea, for Miss Gibbs[19] has already pointed out the fact that this must be considered a center of origin and distribution; this may well be called Papualand. A striking case in support of Miss Gibbs's statement is found in the genus *Couthovia,* long known only from Fiji. In 1898 a third species was described from Celebes which three years later was also found in the Philippines. Recently ten species have been described from New Guinea.

As Sundaland has supplied many ancestral types to the Philippines via the Sulu and Palawan bridges from Borneo, so Papualand has supplied a considerable number to the Philippines, and at the same time various tropical types to northern Australia. It seems to be clear, however, from the following quotation from Sir Baldwin Spencer[20] that tropical types of Papuan origin have not strongly persisted in Australia; a considerable number of striking Australian types have, however, persisted in New Guinea, and some have extended far to the north, occurring throughout the Philippine group.

> It seems probable that the entrance into Australia of the second migration took place in early Pleistocene times, and it is important to note that in succeeding years the hot arid zone gradually crept further and further northwards. This hot arid zone included the northern parts of Australia, and extended across into Papua. The northern littoral of Australia would then have a climate more or less similar to that of Central Australia at the [147] present day. Nothing strikes the traveller in the Northern Territory, right up from the Tropic of Capricorn to Darwin, more than the absence of tropical vegetation. On the eastern coast of Queensland, in parts, there are rich scrubs where the remnants of a flora, and, to a small extent, of a fauna reminiscent of Papua exist. In the very centre of the Continent there is, in the Macdonnel Ranges, entirely isolated and surrounded by tracts of dry arid country spreading over endless distances, just one gorge, 2 miles at most in length, where a small colony of palm trees gives a hint of a past climate very different from that of the present. For the most part, the one striking feature of Northern Australia is the almost entire absence of anything like a luxuriant tropic vegetation or any abundance of animal life.

The intermediate insular region between Sundaland and Papualand has had, as noted above, a geologic history very different from these two continental regions of the Pleistocene (and earlier) to the west and to the east. This region extends northward and includes most of what is now the Philippines, being approximately delimited by Weber's Line to the east and by Wallace's Line, as modified by Dickerson and Merrill, to the west [see the map on p. 224]. It remains unnamed as a unit, but may be conveniently divided into a northern part (Philippine) and a southern part (Celebes, Moluccan, Lesser Sunda Islands). The fauna and the flora of this region, in addition to the relic types dating to the ancient Cretaceous Asiatic-Australian continent, seem to a large degree to be made up of infiltrations from both Sundaland and Papualand. Probably no extensive migrations have taken place between Sundaland and Papualand since the Cretaceous or perhaps the early Tertiary, but intermigrations have been inhibited and at times prevented by the more or less constant archipelagic condition that

[19] **Gibbs, L. S.** Dutch N. W. New Guinea—A Contribution to the Phytogeography and Flora of the Arfak Mountains (1917) 1-126 (p. 39).

[20] **Spencer, Sir B.** Presidential address to the Australian Association for the Advancement of Science, Rept. Fifteenth Meeting Austral. Assoc. Adv. Sci. (1921) LXXXI.

has existed here since the end of the Cretaceous, and which was especially pronounced in the Pleistocene. Thus, it is clear why the Asiatic types of both plants and animals dwindle rapidly in numbers eastward from Macassar Strait, and why there is a corresponding reduction of Australian types westward from New Guinea.

The geographic distribution of the Dipterocarpaceae, as discussed by me,[21] shows the improbability that a former continental land mass covered the entire Malaysian region since the Oligocene and further indicates the fundamental relationship of the Philippine flora with the flora of western and not with that of eastern Malaysia. It is interesting to note [148] the range of genera of the entire Malaysian flora[22] in connection with the same proposition.

In western Malaysia—that is, the Malay Peninsula, Sumatra, Java, Bali, and Borneo, those islands west of Wallace's Line—excluding the manifestly introduced forms, there are about 356 genera which are not known to occur east of Macassar Strait except in the Philippines where 218, or about 61 per cent, are represented. In eastern Malaysia—that is, Celebes, the Moluccas, and New Guinea, all east of Wallace's Line—there are about 225 genera which do not extend to western Malaysia, although 56, or about 25 per cent, reach the Philippines.

It is fully realized that, with the distinctly imperfect knowledge of the Malaysian flora, the numbers cited above will be altered as exploration progresses and various groups of plants are monographed, but it is doubtful if any appreciable change is to be expected in the percentages of exclusively eastern and western Malaysian genera that extend to the Philippines.

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[21] **Merrill, E. D.** Geographic distribution of the Dipterocarpaceae, Philip. Journ. Sci. **23** (1923) 1-33, *t. 1-8*.

[22] Data compiled from the general literature covering the entire region and the following special publications: **Franssen Herderschee, A.**, Nova Guinea. Résultats de l'expédition scientifique néerlandaise à la Nouvelle-Guinée en 1912 et 1913 **12** (1912-17) Botanique (*see* Lorenz); **Hemsley, W. B.**, Report on the Botany of the south-eastern Moluccas, Bot. Challenger Exped. **13** (1895) 101-226; **Koorders-Schumacher, A.**, Systematisches Verzeichnis der zum Herbar Koorders gehörenden * * * Phanerogamen und Pteridophyten III Celebes (1914) 1-144; **Koorders, S. H.**, Exkursionsflora von Java **1-3** (1911-12); **Lauterbach, C.**, Beiträge zur Flora von Papuasien I Engl. Bot. Jahrb. **49** (1912) 1-169; II op. cit. **50** (1913) 1-170; III op. cit. 288-289; IV op. cit. **52** (1914) 19-220; V op. cit. **54** (1916) 69-261; VI op. cit. **55** (1917) 19-125; VII op. cit. **56** (1920) 31-414; **Lorenz, H. A.**, Nova Guinea. Résultats de l'expédition scientifique néerlandaise à la Nouvelle-Guinée en 1907 **8** (1909-13) Botanique (*see* Franssen Herderschee); **Merrill, E. D.**, Reliquiae Robinsonianae, Philip. Journ. Sci. **11** (1916) Bot. 243-319; An interpretation of Rumphius's Herbarium Amboinense (1917) 1-595; A bibliographic enumeration of Bornean plants, Journ. Straits Branch Roy. As. Soc. (1921) 1-637; **King, G.**, and **King** and **J. S. Gamble**, Materials for a flora of the Malayan Peninsula **1** (1889-93) 1-430; **2** (1893-96) 431-802; **3** (1897) 1-608; **4** (1903-09) 1-1126; 5 (1912-1915) 1-468 (Ranunculaceae to Salicaceae) (*see* Ridley); **Ridley, H. N.**, Materials for a flora of the Malayan Peninsula (Monocotyledons) **1** (1907) 1-233; **2** (1907) 1-235; **3** (1907) 1-197 (*see* King); Report on the botany of the Wollaston Expedition to Dutch New Guinea, 1912-13, Trans. Linn. Soc. Bot. **9** (1916) 1-269; The flora of the Malay Peninsula 1 (1922) XXXV, 1-918, *f. 1-75;* 2 (1923) VI, 1-672, *f. 76-131;* **Gibbs, L. S.**, Dutch N. W. New Guinea. A Contribution to the Phytogeography and Flora of the Arfak Mountains (1917) 1-226; **Schumann K.**, and **K. Lauterbach**, Die Flora der Deutschen Schutzgebiete in der Südsee (1901) 1-613, and Nachträge (1905) 1-446.

[149] There are, then, numerous genera from western Malaysia in the Philippines that are not known to occur in eastern Malaysia, and fewer but a striking assemblage of Celebesian, Moluccan, New Guinean, and Australian types extending to the Philippines that do not reach western Malaysia. While there are some "Australian" types in western Malaysia, these are few indeed when compared with the same element in the Philippine flora. In general, the generic distribution in Malaysia as a whole confirms the conclusions that may be drawn from a study of the distribution of the Dipterocarpaceae. It indicates a more-prominent or longer-prolonged connection between the Philippines and Borneo than between the Philippines and the islands to the south, after the breakup of the ancient Cretaceous continent. The Archipelago has received not only Asiatic elements now absent in Malaysia, but also numerous contributions from western Malaysia that could not reach eastern Malaysia on account of physical barriers in the nature of separating seas, and a striking but smaller series from eastern Malaysia that could not reach western Malaysia for lack of direct land connections. It is certain that there has been some intermigration between Borneo in western Malaysia through the Philippines to Celebes and the Moluccas, and probably some through Java to Celebes, but direct land connections between two essential areas, Borneo and Celebes, have been absent.

Borneo, from a Philippine standpoint, is the most interesting part of western Malaysia, for through Borneo most of the western Malaysian elements have reached the Philippines. There are some cases where individual species are at present known only from Java and the Philippines, Sumatra and the Philippines, or the Malay Peninsula and the Philippines, but such cases are few and unimportant; probably all such species will eventually be found in Borneo. There may have been some migration into the Philippines from Java via Celebes.

However, it is perfectly evident that there has been not only an early, probably pronounced, and long-continued connection with Borneo, but also a later, shorter one, or perhaps a series of shorter ones. The first migrants doubtless came in when a continental area existed in the Cretaceous Period, but these were probably all widely diffused Malaysian types. The dominant Dipterocarpaceae arrived in the Miocene or Pliocene, and preceding their arrival and with them came representatives of numerous other families, genera, and species, either widely spread forms or those characteristic of the flora of western Malaysia in [150] general, but which did not reach eastern Malaysia. That there were later shorter periods of land connections through the Sulu group to the south and through Palawan to the north is indicated by the distribution of the genera and species in the Philippines that are known only from Borneo and the Philippines. Most of these must have been late emigrants, because as a rule they do not extend into the Philippines proper but chiefly through the Sulu Archipelago to the Zamboanga Peninsula to the south, and through Balabac and Palawan as far as the Calamian Islands to the north; there are also very slight evidences of late emigrants to western Mindoro and western Panay. This, the last migration of Bornean types, was in the Pleistocene and the Recent.

Zoölogists in general, basing their deductions on the present distribution of mammals, reptiles, birds, and insects, derive the Palawan-Calamian fauna from Borneo, and some[23] even claim that there has been no land connection between the Calamian-Palawan group and the Philippines proper since Palawan received its present fauna. These claims are not borne out by the Palawan flora, which presents a mixture of Bornean and Philippine types, presenting no more special alliances perhaps with Borneo than with the Philippines proper. In fact, the special Bornean elements known in the Palawan flora are distinctly weak in comparison with the remarkably strong Bornean alliances in its fauna. The presence of but one large indigenous mammal, the timarau, in Mindoro proves conclusively that at some time after the rise of the herbivorous mammals connections did exist between Mindoro and Borneo, for the closest ally of the timarau is not the anoa of Celebes, but a species that occurs in Borneo, congeneric with the timarau.

On account of the nature of the floristic alliances of the Philippines with the islands to the southwest, south, and southeast, and the striking fact that Australian types are more numerous and more strongly pronounced in the Philippines than in western Malaysia, it seems worth while to give this subject consideration. Why did the Australian types travel the longer distance, even to northern Luzon, and not the shorter distance to western Malaysia? Why have both eastern and western Malaysian types become dominant in the Philippines without having mutually [151] invaded each other's territory to a greater extent than is the case, although they have mutually invaded the Philippines?

Molengraaff has already emphasized the curved lines of raised islands paralleling the curved lines of deep sea basins in eastern Malaysia. An examination of the map [on p. 224] showing the Malaysian deeps shows that most of these and their paralleling rows of elevated islands curve to the north, thus indicating in general north and south connections rather than continuous east and west ones.

Thus, through the manifest Sulu and Palawan bridges numerous Sundaland types reached the Philippines from Borneo; and through the northward curving lines of islands in the region of the Moluccas and Celebes we have strong evidences of former isthmuses connecting Mindanao with the islands to the south and southeast. It is merely necessary to call attention here to the manifest Sangi bridge between Mindanao and Celebes, and the possible Mindanao-Gilolo bridge through Talaur Island. There is no evidence that these southern connections from Mindanao were ever more than narrow isthmuses since the archipelagic stage was reached, and there is no evidence that even these isthmuses persisted for a great length of time, geologically speaking. Through these north and south connections, however, Australian, New Caledonian, and Papuan types have reached the Philippines, some via the Moluccas, some via Celebes, and at the same time certain Sundaland types extended their range to eastern Malaysia via the Philippines. The east and west land connections across the entire intermediate unstable insular region have apparently not existed, or at least have

[23] **Everett, A. H.** Remarks on the zoogeographical relationships of the island of Palawan and some adjacent islands, Proc. Zool. Soc. London (1889) 220-228, map.

not been sufficiently strong or sufficiently prolonged to allow of many Australian types reaching western Malaysia, and this condition has of course had a marked influence on the intermigrations of eastern and western Malaysian types; in many cases the intermigrations, such as they have been, seem to have been by roundabout routes from Borneo via Mindanao and the Sangi Islands to Celebes, and probably also from Borneo to Celebes via Java and the lesser Sunda Islands, and vice versa.

CONCLUSIONS IN REFERENCE TO THE FLORISTIC RELATIONSHIPS OF THE PHILIPPINES

1. Malaysia as a whole, including the Philippines, was in the Cretaceous a part of the great Asiatic-Australian continent, and the Philippines was then apparently populated with widely dis-[152]tributed Malaysian types, some of which, at least as generic types, doubtless still exist in the present Archipelago.

2. Archipelagic conditions obtained in the late Cretaceous in the ep-Mesozoic interval, or in the Eocene, and since this time Australia and Asia have remained separate and the Philippines have remained essentially insular, although at times they have been connected to the southwest with Borneo, to the south with Celebes and the Moluccas, and perhaps also, directly or indirectly, with Gilolo and New Guinea.

3. The Pleistocene history of Malaysia and the Philippines clearly indicates that two stable continental areas existed, now approximately delimited by the Asiatic and Australian continental shelves. During this period the Sunda Islands were alternately connected and disconnected with Asia, and New Guinea had the same history in relation to Australia. The intermediate region between these two Pleistocene continents was insular, unstable, and subject to great elevations and depressions; it was probably of an insular character in the preceding epochs back to the early Tertiary. The Philippines, for the most part, forms a part of this unstable area.

4. Connections between the Philippines and Formosa and southeastern Asia were broken in the early Tertiary, the break being persistent since that period. This is verified by the great dissimilarity between Formosan and Philippine faunas and floras, and the fact that Australian and eastern Malaysian types which are strongly represented in the Philippines failed to reach Formosa, while the dominant dipterocarps of the Philippines are entirely absent. The Malaysian element in Formosa reached that island via Indo-China and southern China, when Formosa was a part of Asia.

5. There was a pre-Tertiary migration of Asiatic types into Malaysia via the Philippines, indicated by representatives of some thirty-four Asiatic genera in the Philippine flora that are otherwise unknown from Malaysia. The Asiatic-Philippine route to Malaysia was much less important than the Malay Peninsula-Sumatra route which, with interruptions, persisted through the Pleistocene and probably into the Recent.

6. The Philippine flora is overwhelmingly Malaysian and is made up of types from both western and eastern Malaysia. The general alliances are apparently stronger with the Sunda Islands than with the islands to the south and southeast, as shown by the fact that of the three hundred fifty-six western Malaysian genera not occurring in eastern Malaysia, two hun-

dred eighteen [153] or about 61 per cent, reached the Philippines, while of two hundred twenty-five eastern Malaysian genera that do not extend to western Malaysia fifty-six, or about 25 per cent, reached the Philippines.

7. Land connections between the Philippines and other parts of Malaysia have apparently not been other than isthmuses since the archipelagic condition was attained. The Palawan and Sulu bridges connecting the Archipelago with Borneo must have been strongly pronounced or greatly prolonged to allow the migration of the dominant western Malaysian types into the Philippines. These connections were later broken, allowing later migrations into the Palawan-Calamian group to the north which failed to pass Mindoro Strait. The Palawan-Calamian group in the Pleistocene formed a part of Borneo, but was not then connected with the Philippines.

8. Land connections between the Philippines and the islands to the south and southeast of the Archipelago have never been more than narrow isthmuses since the breakup of the Cretaceous continent. These connections have not been so pronounced or so long continued as was the case with the Bornean connections.

9. The general north and south connections made it possible for both eastern and western Malaysian types to reach the Philippines, but inhibited their east and west distribution in the Archipelago as a whole. Thus, a considerable number of Australian, New Caledonian, and Papuan types have traveled the longer distance into the Philippines, while very few reached the Sunda Islands, and many western Malaysian types extended northward into the Philippines that failed to reach eastern Malaysia.

10. Australian types in the Philippine flora are more numerous and more strongly pronounced than are similar types in western Malaysia. This is explainable by the geologic history of the intermediate insular area between eastern and western Malaysia.

11. In considering Malaysia as a whole it is clear that two secondary centers of origin and distribution have been established since the breakup of the Cretaceous continental area. One of these is composed of the Sunda Islands, or Sundaland; the other is New Guinea, or Papualand.

12. The intermediate insular area between Sundaland and Papualand is approximately delimited by Wallace's Line to the west and Weber's Line to the east. Neither is an absolute biogeographic boundary, but they may have approximately equal values. Both are due to fundamental geologic conditions, [154] being respectively the western and eastern boundaries of an unstable, orogenetically active, insular area where it impinges on the old stable continental areas to the west and to the east.

13. The fauna and the flora of this unstable insular area are to a large degree made up of the original Cretaceous and possibly early Tertiary relic forms plus infiltrations from both Sundaland and Papualand. In this region Asiatic types rapidly decrease east of Macassar Strait, and Australian types decrease with equal rapidity west of New Guinea, results to be logically expected in view of the geologic history of this unstable insular region.

14. The indicated geographic alliances of the Philippine flora are in close conformity with the faunistic alliances, and both conform remarkably to the geologic history of Malaysia of which the Philippines forms a part.

— VIII —

LEPROSY BOWS TO SCIENCE*

[79] This race-old disease, long considered incurable, popularly supposed to be highly contagious, and so thought of by the majority of physicians, is yielding to modern science. Yet it is only within the present century that an effective method of treating leprosy has been discovered. Based on research done by numerous individuals in India, Egypt, England, the Philippines, and Hawaii on the application of certain derivatives of chaulmoogra oil as a curative agent, really effective progress is being made in the cure of this disease for which we all have an ingrained horror.

More recent investigations seem clearly to indicate that leprosy, rather than being a contagious disease, is really transmissible directly from one individual to another only to a limited degree if, indeed, at all. It is caused by a widely distributed soil organism, the disease resulting from the accidental contact of cuts or abrasions with infected soil.

No investigator, in more than forty recorded cases of attempted transmission of the disease of leprosy in human beings, has succeeded in producing leprosy as an unquestioned result of inoculation. From this experimental record alone it would seem to be clear that the lepra organism, as it occurs in the tissues of infected [80] human beings, is ordinarily incapable of directly transmitting the disease to another individual. In those countries where rather strict segregation of lepers has been practiced for a long time the incidence of the disease among the general population not at all in contact with the segregated lepers, is today as high as it was when segregation was begun. Logically, were leprosy really contagious, we would expect not only a rather high degree of infection among attendants in leprosaria, but also in those countries where segregation is strictly enforced, a gradual decline over a period of years, in the number of individuals contracting the disease. It is not to the credit of modern civilization that the unfortunate victims of this disease are treated as worse than social outcasts, as individuals to be shunned, who should have no contact with their fellowmen.

Perhaps familiarity breeds contempt. I have lived long in the Philippines, where leprosy is by no means uncommon; I have been familiar with the work of the San Lazaro leper hospital in Manila, and with the great leper colony at Culion from its very inception; I have seen numerous cases of leprosy in all stages and realize that among the very numerous individuals associated with the leprosaria as physicians, nurses, attendants, and other employees, practically no cases of infection occur. Also I am familiar with the fact that numerous actual cures are being effected.

Thus it is perhaps to be expected that I was not greatly disturbed when I discovered several years ago that one of my household servants was a leper, and that the disease had been present in an incipient stage during the three years that this individual had been employed by me. Yet within a few months after the case had been reported and the individual placed un-

* E. D. MERRILL, "Leprosy Bows to Science" (Review of Reviews 80:79-80, 1929).

der proper hospitalization, a permanent cure was effected and the patient was therefore discharged.

From recent investigations, notably those of Dr. E. L. Walker, of the Hooper Foundation for Medical Research, University of California, initiated in the Philippines some years ago, and more recently continued in Honolulu and in San Francisco, it would seem that the popular conception that leprosy is contagious is erroneous in the extreme, as I have indicated above. Furthermore, it has been demonstrated that the causative organism is not a true bacterium, as has long been thought, but is really a primitive fungus of the genus *Actinomyces*, a soil organism of very wide distribution in nature.

The microorganism causing leprosy was observed as early as 1871, but all attempts to cultivate it resulted in the growth of a great variety of forms apparently different from the acid-fast, bacteria-like bodies found in the lesions of leprosy. This bacteriological puzzle has been cleared up by experimental proof of what some investigators had already suspected, namely, that the lepra organism is not a simple bacterium but is a fungus intermediate between the true fungi and the bacteria, which assumes rather protean forms, with various reactions to stains during its life history. This *Actinomyces*, belonging in the same genus as the organism which causes the well-known lumpy jaw in cattle, a disease never considered to be contagious, is a saprophyte, that is, an organism living in decaying vegetable matter, in this case in the soil; but the lepra organism can become a parasite when it accidentally gains admission to the living tissues of man. Infection takes place not through direct contact with infected individuals, but through the the contact of cuts or abrasions with contaminated soil.

With these new ideas as to the source and infectivity of leprosy and the non-contagious nature of the disease, it can readily be understood why persons in close association with diseased individuals in leprosaria escape infection; why leprosy is not a common disease in countries having high standards of sanitation; why in most countries where shoes are regularly worn by the majority of the people, infection is rare; and why the disease is prevalent in those countries where most of the population goes barefoot for a part or much of the time, and where the general standards of sanitation are low. It also becomes clear why leprosy, once more or less prevalent in Europe, has become automatically eliminated through the general advance in the standards of living and of sanitation; and why there has been no drop in the incidence of leprosy in those countries where strict segregation of lepers has been practised for a considerable period.

But, although we now know that leprosy is not dangerous in the sense that contagious diseases are, this does not mean that leprosaria are no longer needed. The need for institutions where the unfortunate victims of this disease can receive proper care and treatment is still as great as it ever was. It should mean, however, a realignment of our ideas concerning leprosy; the establishment of rational treatment of infected individuals; the removal of a long-standing blot on civilization in our inhuman treatment of lepers in the past, and an entire realignment of official and popular conceptions as to the nature of the disease and its transmission.

ONE-NAME PERIODICALS*

[1] Brittonia, planned primarily to cover the fields of systematic botany and plant geography, although papers in other fields are not excluded, is named in honor of Nathaniel Lord Britton, Secretary of the New York Botanical Garden from its establishment, February 12, 1895, to August 1, 1929, and its Director-in-Chief from July 1, 1896, to August 1, 1929. It was originally suggested that a special volume of the Memoirs of the New York Botanical Garden, dedicated to Dr. Britton, be issued in appreciation of his services in establishing and directing the destinies of the institution from its inception until his retirement in 1929. This matter was discussed at the meetings of the Scientific Directors and the Board of Managers on January 11 and 13, 1930, respectively. Attention was called to the fact that the Garden did not maintain a periodical covering the technical field of botany in which miscellaneous contributions from the staff, and also papers prepared by other than staff members, based in part or entirely on its own material, could be published. After a consideration of this situation it was the unanimous opinion of members of the Scientific Directors and of the Board of Managers present at the meetings that such a periodical should be established and maintained by the Garden. Under the circumstances, the selection of the name BRITTONIA for this new periodical is appropriate, thus establishing a continuing memorial to the man through whose enthusiasm, ability and foresight the establishment of The New York Botanical Garden became an assured fact, and who directed its development and destiny for a period of thirty-three years.

The principle of single-name technical and semi-technical periodicals is well established, in such names as "Alpina," "Anthropologia," "Appalachia," "Archaeologia," "Arktis," "Ecology," "Erythea," "Flora," "Gaea," "Genetica," "Genetics," "Globus," "Hereditas," "Isis," "Kosmos," "Madroño," "Mazama," "Min-[2]erva," "Mycologia," "Nature," "Phytopathology," "Planta," "Proteus," "Psyche," "Rhodora," "Science," "Sinensia," "Tectona," "Terra," "Ymer" and "Zoe," some of these titles being descriptive of the field actually covered; to be included here is another long series of nearly one-word titles, illustrated by "The Auk," "The Bryologist," "La Cellule," "The Condor," "The Ibis," "La Géographie," "L'Universo," "The Mountaineer," "The Oologist," and "The Phytologist." There is another category of one-name publications dedicated to scientists and others who have attained eminence in their particular fields, these being listed below. A few have been single volumes, such as "Dodonaea," "Fuchsia," and "Lobelia," but most of them have taken the form of periodicals, many having had long and honorable histories; thus among the 41 periodicals listed below, 17 are still being published, and among these "Hedwigia" has appeared regularly for 78 years, and "Leopoldina" for 71 years. Other individuals have been honored in the titles of such periodicals as "The Asa Gray Bulletin," "The Bulletin of the Torrey Botanical Club," "Contributions from the Dudley Herbarium of Stanford University," "Con-

* E. D. MERRILL, "One-Name Periodicals" (Brittonia 1:1-5, 1931).

tributions from the Gray Herbarium of Harvard University," "The Wilson Bulletin, a Quarterly Journal of Ornithology," "The Bulletin of the Cooper Ornithological Club," and "The Bulletin of the Nuttall Ornithological Club." The shorter title is favored for the very obvious reason of brevity.

Diverse fields are covered by these publications dedicated to individuals, such as general natural history, general botany, systematic botany, cryptogamic botany, phycology, cecidology, agriculture, zoology, entomology, ornithology, herpetology, etc. Among these one-name titles derived from the names of individuals may be cited the following:

ADANSONIA. Recueil périodique d'observations botaniques. 1860-1879.
Michel Adanson, 1727-1806.

ADDISONIA. Colored illustrations and popular descriptions of plants. 1916– →
Addison Brown, 1830-1913.

BARTONIA. Proceedings of the Philadelphia Botanical Club. 1908– →
William Paul Crillon Barton, 1786–1856.

BILLOTIA. Ou Notes de botanique. 1864-69.
Paul Constant Billot, 1796–1863.

BONPLANDIA. Zeitschrift für die gesammte Botanik. Officielles Organ der K.L.-C. Akademie der Naturforscher. 1853–1862.
Aimé Jacques Alexandre Bonpland, 1773–1858.

[3] BOTHALIA. A record of Contributions from the National Herbarium, Union of South Africa, Pretoria. 1921– →
Louis Botha, 1862–1919.

BREBISSONIA. Revue mensuelle illustrée de botanique cryptogamique et de l'anatomie végétale. Organe de la Société Cryptogamique de France. 1878–1882.
Louis Alphonse de Brébisson, 1798–1872.

BROTERIA. Revista de sciencias naturaes do Collegio de S. Fiel. 1902-1916.
Felix da Silva Avellar Brotero, 1744–1828.

CANDOLLEA. Organe du Conservatoire et du Jardin botaniques de la ville de Genève. 1922– →
Augustin Pyramus de Candolle, 1778–1841.
Alphonse Louis Pierre Pyramus de Candolle, 1806–1893.
Anne Casimir Pyramus de Candolle, 1836–1918.
Richard Emile Augustin de Candolle, 1868-1920.

CASSINIA. A bird annual. Proceedings of the Delaware Valley Ornithological Club of Philadelphia. 1890– →
John Cassin, 1813–1869.

CAVANILLESIA. Rerum botanicarum acta. 1928– →
Antonio José Cavanilles, 1745–1804.

COPEIA. A journal of cold-blooded vertebrates. 1913– →
Edward Drinker Cope, 1840–1897.

DODONAEA. Ou Recueil d'observations de botanique. 1841–1843.
Rembert Dodoens (Dodonaeus), 1517–1585.

FUCHSIA. Ou Recueil d'observations de botanique, d'agriculture, d'horticulture et de zoologie. 1849.
Leonhard Fuchs, 1501–1566.

GREVILLEA. A monthly record of cryptogamic botany and its literature. 1872–1894.
Robert Kay Greville, 1794–1866.

HEDWIGIA. Ein Notizblatt für kryptogamische Studien. 1852– →
Johann Hedwig, 1730–1799.

HILGARDIA. A Journal of Agricultural Science published by the California Agricultural Experiment Station. 1925– →
Eugene Woldemar Hilgard, 1833–1916.

IRMSCHIA. Correspondenzblatt des botanischen Vereins für das nördliche Thüringen. 1881–1886.
Johann Friedrich Thilo Irmisch, 1816–1879.

KONOWIA. Zeitschrift für systematische Insectenkunde (mit Ausschluss von Coleopterologie und Lepidopterologie) unter Mitwirkung führender Entomologen. 1922- →
Friedrich Wilhelm Konow, 1842–1908.

LEOPOLDINA. Amtliches Organ der Kaiserlich Leopoldinisch-Carolinischen Deutschen Akademie der Naturforscher, 1859–1923. Succeeded by LEOPOLDINA. Berichte der Kaiserlich Deutschen Akademie der Naturforscher zu Halle. 1926- →
Kaiser Leopold I, 1640–1705.

[4] LINDENIA. Iconographie des Orchidées. 1885–1906.
Jean Jules Linden, 1817–1898.

LINNAEA. Ein Journal für die Botanik in ihrem ganzen Umfang. 1826–1882.
Carolus Linnaeus, 1707–1778.

LOBELIA. Ou Recueil d'observations de botanique et spécialement de tératologie végétale. 1851.
Matthias de l'Obel (Lobelius), 1538-1616.

LORQUINIA. 1916–1917.
Pierre Joseph Michel Lorquin, 1797–1873.

MALPIGHIA. Rassegna mensuale di botanica. 1886- →
Marcello Malpighi, 1627–1694.

MARCELLIA. Revista internationale di Cecidologia. 1902- →
Marcello Malpighi, 1627–1694.

MICHELIA. Commentarium mycologicum fungos in primis Italicos illustrans. 1877–1882.
Pier' Antonio Micheli, 1679–1737.

MUHLENBERGIA. A journal of botany. 1900–1917.
Gotthilf Henry Ernest Muhlenberg, 1753–1815.

NAUMANNIA. Journal für die Ornithologie. 1849–1858.
Johann Friedrich Naumann, 1780–1857.

NOTARISIA. Commentarium Phycologicum. Revista trimestrale consacrata allo studio delle alghe. 1886–1896. This became "La Notarisia. Commentario ficologico generale. Parte speciale della Revista Neptunia" in 1891. See also "La nuova Notarisia" 1890–1925.
Giuseppe De Notaris, 1805–1877.

PITTONIA. A series of papers relating to botany and botanists. 1887–1905.
Joseph Pitton de Tournefort, 1656–1708.

POSTELSIA.[1] The yearbook of the Minnesota seaside station. 1901–1906.
Alexander Postels, 1801-1871.

PRESLIA. Věstnik Československé Botanické Společnosti (Reports of the Czechoslovak Botanical Society of Prague). 1914- →
Jan Swatopluk Presl, 1791–1849.
Karel Boriwog Presl, 1794–1852.

REDIA. Giornale di Entomologia pubblicato dalla R. Stazione de Entomologia Agraria in Firenze. 1903- →
Francesco Redi, 1626–1698.

RETZIA. Sive observationes botanicae. 1855–1856.
Anders Johan Retzius, 1742–1821.

SIEBOLDIA. Weekblad voor den tuinbouw in Nederland; tevens orgaan der Boskoopsche Pomologische Vereeniging. 1875-1883.
Philipp Franz von Siebold, 1796–1866.

SUNYATSENIA. Journal of the Botanical Institute, College of Agriculture, Sun Yatsen University, Canton, China. 1930- →
Sun Yatsen, 1866–1925.

[5] TEYSMANNIA. 1890–1922.
Johannes Elias Teijsmann, 1809–1882.

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[1] This name may have been derived from the generic name *Postelsia*, a genus of algae, but the genus was named in honor of Alexander Postels. The origin of the name is not explained in the publication.

TORREYA. A monthly journal of botanical notes and news. 1901- →
John Torrey, 1796-1873.
TREUBIA. Recueil de travaux zoologiques, hydrobiologiques et océanographiques. 1919- →
Melchior Treub, 1851–1910.
WEBBIA. Raccolti di scritti botanici. 1905–1923.
Philip Barker Webb, 1793–1854.

It is planned to issue the various numbers of BRITTONIA at irregular intervals, as material becomes available for publication. The individual volumes will be of approximately 500 pages. While it is conceivable that under some circumstances more than one volume may be issued within a single year, yet at the beginning, probably more than a year will elapse before the completion of the first. May the standards of this new periodical be such as to reflect credit on the institution that sponsors it, and honor on the individual whose name it bears.

—X—

ON LOUREIRO'S "FLORA COCHINCHINENSIS"*

[1] There are certain types of botanical publications that have caused much trouble to systematists who have attempted to monograph various groups of plants. The difficulties in dealing with such works are due to various causes, chiefly inaccurate, inadequate, or indefinite original descriptions of genera and species included in them and, as far as later investigators are concerned, absence or inaccessibility of authentically named specimens for purposes of study and comparison. Where later systematists have had access to botanical material examined by earlier authors in the preparation of their publications, the problems as a rule have been easily solved. In works like Blanco's "Flora de Filipinas" where that author preserved no botanical material, and Loureiro's "Flora Cochinchinensis" where such botanical material as was prepared by him has partly been destroyed, the problem of determining the status of numerous genera and species described, in relation to those proposed and described by other authors, becomes a distinctly complicated one. In the case of those publications based on regions where the floras, for all practical purposes, are now thoroughly well known, it has usually been possible to determine the status of most of the forms described by the early authors; but when older publications were based on material from regions as yet imperfectly explored, such as the Philippines and Indo-China, the problem is decidedly more difficult.

The author of a monographic treatment of any natural group, such as a family, a genus, or a subgenus, normally attempts to account for all species and binomials proposed in such groups, while the author of a flora of a definite region normally attempts to account for all species that have been credited by other authors to the area he is attempting to cover. All systematists realize that some monographic treatises and various published floras fall far short of this indicated goal. This is because some authors, either because of personal inclination or belief, on account of various difficulties encountered, or because of the absence or inaccessibility of authentic material, or the unavailability of certain published papers, follow the lines of least resistance, treating fully those species well known to them, treating sketchily those imperfectly known, and leaving a residue of obscure ones in such categories as "species incertae sedis," "species dubiae," "species exclusae" and "inextricabiles," and not infrequently ignoring binomials entirely which, for one reason or another, are more or less obscure.

One regrettable result of the publication of such works as those of Blanco and Loureiro is that systematic botanical literature is overburdened with a large number of binomials either proposed by the original authors or those based by later systematists on the original imperfect descriptions that most modern authors have not been able to place to their full satisfaction. Loureiro's binomials and those proposed by his successors, but based on his

* Excerpts from the introductory data to E. D. MERRILL's, "A Commentary on Loureiro's 'Flora Cochinchinensis' " (Transactions of the American Philosophical Society, N. S. 24:1-13, 19-23, 28-29, 33-35, 38-49, 1935).

original descriptions, bulk large in many lists of unknown or imperfectly understood genera and species. It has therefore seemed desirable to make a rather intensive study of all of his descriptions with a view to placement of his binomials, as far as they can be placed in the light of our present knowledge, in relation to those proposed by other authors, and at [2] the same time to attempt to account for the very numerous binomials proposed by later authors but based on Loureiro's descriptions.

Certain Pre-Linnaean Publications

Among the pre-Linnaean publications on the Indo-Malaysian flora, whose illustrations and descriptions typify a large number of binomials proposed by Linnaeus and his successors, may be mentioned Rheede's "Hortus Malabaricus," eleven volumes, folio (1678-1703); Rumphius' "Herbarium Amboinense," six volumes, and "Auctuarium," folio (1741-55); Burman's "Thesaurus Zeylanicus" (1737); and Linnaeus' "Flora Zeylanica" (1747). In the case of the last two works much of the botanical material on which they were based is still extant, but of the first two it is manifest that no botanical material was prepared or, if specimens were prepared, this was done with no idea of their preservation; hence all binomials based on the work of Rheede and Rumphius must be interpreted solely on the basis of the generalized non-technical descriptions and rather crude illustrations given in the original publications.

Burman's material on which the "Thesaurus Zeylanicus" was based is, at least in part, preserved in the Delessert Herbarium, now at the Jardin Botanique at Geneva, Switzerland, and that on which the "Flora Zeylanica" was based is now preserved in the herbarium of the British Museum, Natural History, London. The extant "Thesaurus Zeylanicus" material does not appear to have been critically studied by any modern botanist, but Trimen[1] has done this for Hermann's Ceylon collections on which the "Flora Zeylanica" was based. Trimen's work is invaluable as an aid in determining the exact status of many of the Linnaean binomials typified by the specimens named and briefly described in the "Flora Zeylanica" (1747) and even more briefly characterized in the "Species Plantarum" (1753). Trimen, however, neither in his original paper nor in his succeeding work, "Handbook of the Flora of Ceylon" (1894-1900), interpreted the Linnaean binomials in accordance with the principles of priority but usually adopted names in current use instead of making the new combinations necessitated by the rule of priority.

Several attempts have been made to interpret the species described by Rheede[2] and by Rumphius[2] in view of their importance in relation to the

[1] **Trimen, H.** Hermann's Ceylon herbarium and Linnaeus' 'Flora Zeylanica.' Journ. Linn. Soc. Bot. 24: 129-155. 1887.

[2] **Burman, J.** Index universalis in sex tomos et auctuarium herbarii Amboinensis Cl. Georgii Everhardi Rumphii. Herb. Amb. Auct. [1-20]. 1755.

Burman, J. Index alter in omnes tomos herbarii Amboinensis cl. G. Everhardi Rumphii, quem de novo recensuit, auxit et emendavit Joannes Burmannus [1-22]. 1769.

This was issued in connection with Burman's index to Rheede's Hortus Malabaricus and is sometimes bound in the last volume of that work.

Anonymous. Register op het Ambons Kruid-Boek van G. E. Rumphius. 1-16. 1764.

exact status of numerous bi-[3]nominals, based wholly or partly on data given in these pre-Linnaean works. The problems involved are by no means simple, and none of the publications based on these two fundamental botanical works are entirely satisfactory. What is particularly needed in reference to the unsolved problems of Rheede and Rumphius are more intensive explorations of the classical localities in India and in the Moluccas, the field work to be carried on over considerable periods of time with special reference not only to the descriptive data given by these pre-Linnaean authors but also with very special reference to the native names cited, habitats, and indicated economic uses of the plants they described. Until this is done and these data correlated with binomial nomenclature, we shall continue to guess at what numerous binomials typified by references to these pre-Linnaean works are supposed to represent, but with more comprehensive collections, together with full field data from the classical localities, we can in most cases approach the position of exactness.

Certain Post-Linnaean Publications

Among the post-Linnaean publications on the Indo-Malaysian flora that have caused numerous difficulties to later systematists are Burman's "Flora Indica" (1768); Loureiro's "Flora Cochinchinensis" (1790, Willdenow's edition, 1793); and Blanco's "Flora de Filipinas" (1837, ed. 2, 1845).

Some years ago[3] I made an attempt to determine the status of Burman's new species as far as this could be done from a study of the short descriptions and the illustrations; but this work needs correction and amplification through an examination of Burman's extant types at Geneva. Unfor-

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Copy in the library of the British Museum, Natural History. See Britton, J. Journ. Bot. **56**: 363-364. 1918.

Linnaeus, C. Herbarium Amboinense, quod consens. experient. Facult. Medicae in Regia Academia Upsalensi, sub praesidio viri nobilissimi atque experientissimi, Dn. Doct. Caroli Linnaei . . . publico examini submittit, Alumnus Regius Olavus Stickman. i-iv, 1-28. 1754.

Republished with slight alterations under the title: Herbarium Amboinense, sub praesidio D. D. Car. Linnaei, proposuit Olavus Stickman. Amoen. Acad. **4**: 112-143. 1759.

Buchanan-Hamilton, F. Commentary on the Herbarium Amboinense. Liber Primus. Mem. Wern. Soc. **5**: 307-383. 1826.

Buchanan-Hamilton, F. A commentary on the second book of the Herbarium Amboinense. Op. cit. **6**: 268-333. 1832.

Henschel, A. G. E. T. Clavis Herbarii Amboinensis: in his Vita G. E. Rumphii. 139-202. 1833.

Hasskarl, J. K. Neuer Schlüssel zu Rumph's Herbarium Amboinense. Abh. Naturf. Gesellsch. Halle **9**: 145-389. 1866. Reprint 1-247. 1866.

Merrill, E. D. An interpretation of Rumphius's Herbarium Amboinense. Bur. Sci. Publ. **9**: 1-595, map, 1917.

Burman, J. Flora Malabarica, sive index in omnes tomos horti malabarici, quem juxta normam a botanicis hujus aevi receptam conscripsit, et ordine alphabetico digessit. 1-10. 1769.

Dennstedt, A. W. Schlüssel zum Hortus Indicus Malabaricus. 1-40. 1818.

Buchanan-Hamilton, F. Commentary on the Hortus Malabaricus. 1-410. 1822.

[**Dillwyn, L. W.**] A review of the references to the Hortus Malabaricus of Henry van Rheede van Draakenstein. i-viii, 1-69. 1839.

[3] **Merrill, E. D.** A review of the new species of plants proposed by N. L. Burman in his Flora Indica. Philip. Journ. Sci. **19**: 329-388. 1921.

tunately the Burman herbarium was not retained as a special collection, the specimens being scattered through the large general herbarium, so that it is frequently difficult to locate specific types, and some of these are apparently no longer available. Various specialists, in monographing genera or families, have examined many of Burman's specimens and have prepared amplified descriptions based, at least in part, on the original material.

Blanco, as noted above, preserved no botanical material, describing his species from time to time over a period of many years as he had the opportunity of examining fresh specimens. His work is notably uneven and naturally contains numerous errors, both of [4] observation and of interpretation. In 1905 I made a preliminary study of Blanco's species[4] for use chiefly as a guide for what needed to be done, and thirteen years later published a more extensive work[5] in which each Blancoan species was more or less critically considered. This publication was supplemented by sixteen sets of duplicate botanical specimens, each set containing 1060 specimens, which were distributed to the larger herbaria in Europe, America, and Asia, the specimens being selected to represent Blanco's species as I then understood them. Through an intensive knowledge of the Philippine flora, particularly of those regions familiar to Blanco, and through a study of each description together with a careful consideration of other data, native names, localities, habitats, times of flowering, and economic uses, supplemented by special trips to special localities to search for individual species, it became possible definitely to place all but one of Blanco's twenty-three new genera, and all but about fifty of the 1136 species and varieties described by him, including the 636 that he described as new. In my studies of such species based on Rumphius and on those proposed by Burman, Blanco, Llanos[6] and others, I was actuated by a desire to determine as far as possible the status of the numerous species described by these authors, and the numerous new binomials proposed by later authors but based wholly on these usually inexact, often incomplete, and in other ways unsatisfactory early descriptions, and to correlate the species with those described by other authors under other names.

In 1919 I completed a preliminary study of Loureiro's species, following the same principles that had guided me in the other studies mentioned above. The result was i-xxxvii + 1-693 pages of typescript which was prepared in sextuplicate. To stimulate further work on the numerous unsolved problems, copies were sent to the British Museum, Natural History, London; the Museum d'histoire naturelle, Paris; the Institut scientifique, Saigon, Indo-China; the United States Department of Agriculture, Washington; and to the Canton Christian College (now Lingnan University), Canton, China. This manuscript stimulated the preparation of several important papers[7] based on Loureiro's extant types in the herbarium of the British Museum which have solved numerous problems in relation to Lou-

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[4] **Merrill, E. D.** A review of the identifications of the species described in Blanco's Flora de Filipinas. Govt. Lab. Publ. [Philip.] **27:** 1-132. 1905.

[5] **Merrill, E. D.** Species Blancoanae. A critical revision of the Philippine species of plants described by Blanco and by Llanos. Bur. Sci. Publ. **12:** 1-423. 1918.

[6] The Philippine species of Llanos are considered in Species Blancoanae.

[7] See special bibliography, p. 23 [of original publication].

reiro's genera and species, problems that could scarcely otherwise have been solved because of Loureiro's faulty descriptions; yet while I, and doubtless some other botanists, look on these contributions to stability in nomenclature as distinctly important, others will sympathize with Gagnepain[8] whose review of Moore's papers merely states: "L'auteur, après Elmer D. Merrill, a essayé s'appuyant sur la collection de Londres, de donner aux plantes de Loureiro une synonimie certaine. Malgré de très louables efforts, il n'a pas toujours réussi." Moore incidentally placed definitely about twenty-five genera described by Loureiro, many of which previous authors had failed to interpret (even to the extent of determining to what families they belonged), supplied the information that rendered it possible to place two other misunderstood and unplaced genera, and definitely settled the status of about fifty species, previously just as doubtful as the genera above mentioned. [5] He also indicated certain valid Indo-China species that had been overlooked by the authors of the "Flore générale de l'Indo-Chine," of which actual types are extant.

The Bearing of the International Code on the Present Problem

As long as botanists were content to follow conventional usage in adopting binomials without regard to the historical aspects of each individual case and without regard to priority—and some botanists still do this—the question of the exact identity of a doubtful species proposed by any early author was perhaps of little importance. With the rapidly increasing tendency to adopt the principle of priority, modified by the lists of *nomina generica conservanda* approved by the International Botanical Congresses held at Vienna (1905), Brussels (1910), and Cambridge (1930), the exact status of each unit, whether genus or species, proposed by early authors and long considered as imperfectly known or of doubtful status, becomes distinctly important in connection with the question of stability in nomenclature. If we are to follow the principles of priority in selecting names of described species, we cannot hope even to approach the desired stability until the exact status of a high percentage of all doubtful species proposed by early authors shall be determined. It is evident that the desired end cannot be attained by even the most critical revision of any one or two of the early botanical works which contain the descriptions of numerous new genera and species, the status of many of which are uncertain. The solutions of numerous problems presented by the publications of Rheede, Rumphius, Burman, Blanco, Loureiro, and others, demand an intensive and sympathetic study of their works, some more particularly in reference to the known extant botanical collections on which they were based, others with intensive field work in the classical localities whence the several authors secured their material. In the latter cases the field work should be combined with an intensive study of each individual description and illustration and of all additional data given by each author in comparison with extensive collections of botanical material.

While the preliminary examination of Loureiro's work in 1919 clearly indicated that the proper interpretation of his numerous genera and species

[8] **Gagnepain, F.** Bull. Soc. Bot. France **73**: 752-753. 1926.

presented an exceedingly difficult series of problems, yet it was believed that an application of the methods followed in the study of the Rumphian and Blancoan problems would yield productive results, and that it was not only possible but highly probable that a high percentage of Loureiro's numerous doubtful genera and species could definitely be placed. From the standpoints of priority and of stability in nomenclature, a critical study of Loureiro's "Flora Cochinchinensis" seemed to me to be the most important need in reference to all of the post-Linnaean publications appertaining to the flora of the Indo-Malaysian region.

The International Code of Botanical Nomenclature recognizes the principle of priority, limited only by the approved lists of *nomina generica conservanda,* and most botanists now follow this Code in principle. We can therefore no longer ignore the imperfectly described species of various early authors. To each individual case the historical method of research should be applied, and where the actual types are no longer extant, all possible means should be employed for the purpose of locating definitely the various more or less doubtful species and determining their status in reference to those described by other authors. Dr. H. Handel-Mazzetti[9] has urged that in order not to upset established and accepted nomenclature more than is necessary, great caution should be exercised in adopting Loureiro's [6] names. All taxonomists will admit the correctness of this position; yet when the definite status of any of Loureiro's numerous doubtful species can be determined, the logical course to follow is to accept the name in accordance with the rules of procedure in such cases, provided it is valid and has priority. Without some definitely established system for determining the proper binomial for each individual species and for adjusting the synonymy in each individual case, it would be useless to attempt an interpretation of the numerous binomials based on the work of such early authors as Rheede, Rumphius and the older Burman, or the species described under the binomial system by the younger Burman, Loureiro, and Blanco. If we assume one attitude toward Linnaean species, are we justified in adopting a totally different attitude toward Loureiroan, Blancoan, or de Candollean species, or even those proposed by our own contemporaries? The task, if performed at all, should be done in accordance with the principles of priority. Accordingly, in my previous publications of this type I have not hesitated to adopt older, valid, specific names, even when they replaced long-established and well-known binomials in current use and do not hesitate to make new combinations in the present work where such a course is indicated.

It is realized that this procedure is markedly different from that of most of the contributors to Lecomte's "Flore générale de l'Indo-Chine" (1906-35+) which covers the area of the old Kingdom of Cochinchina. In this modern work one would logically expect to find, if not admitted as a species, at least mentioned as synonyms or in notes, all or most of Loureiro's species that were based on Cochinchina material, as well as the even more numerous binomials proposed by later authors but based on Loureiro's descriptions of Cochinchina plants. Yet within the families treated in the published parts of this important contribution to our knowledge of the flora of tropical Asia up to the end of 1934, I note nearly 400 binomials, either those

[9] Rept. Proc. Fifth Internat. Bot. Congr. Cambridge, 536. 1931.

of Loureiro or those based on Loureiro's descriptions of Indo-China plants, that are not mentioned; and some of these omissions even include genera and species recognized by all botanists as valid and of which the actual types are extant.

Some botanists do not fully approve of the type of bibliographical and botanical work characterized by my attempts to clarify the binomials based on Rumphius' "Herbarium Amboinense," and more definitely to place the species proposed by Blanco, Llanos, Burman f., and Loureiro, in so far as this work involves changes in accepted nomenclature. On the other hand, the value of such work is appreciated by others, in spite of the necessary changes of names involved. While I personally consider this type of work important, I can scarcely expect that my contemporaries and successors will agree with me in all of my interpretations, or will accept all the proposed changes in nomenclature. The facts are presented as clearly as possible and the data are thus available to those who care to check my conclusions. It gives me distinct personal satisfaction to clarify the status of an overlooked, forgotten, or obscure genus or species, and my own reaction is that this type of work fully justifies the time and effort devoted to it.

With due mental reservations as to the type of taxonomic work prosecuted by that remarkable but erratic genius, C. S. Rafinesque, which is rather generally ignored by most taxonomists, I cannot refrain from quoting the first paragraph from the preamble to the fourth and last part of his "Flora Telluriana" (1838):

"In the process of this work I have met with many interruptions and disappointments. It is neither easy nor agreeable to stem the current of botanical errors and blunders, and whoever swims against the streams of scientific prejudice may reckon on difficulties. I have [7] met such in all my attempts to increase and correct knowledge; but I persevere nevertheless, and write for posterity rather than the actual Schools. I feel that my weary labors are not now appreciated except by a few, but am confident that in 50 years hence they will be more valued. Of this I have received already some assurances, when young and skilful Botanists have partly approved and adopted my views."

Rafinesque was at least optimistic regarding the value of his work to posterity, but he would probably be gravely disappointed at the current lack of appreciation of his "weary labors" even one hundred years after his results were published.

Loureiro and His Work

João de Loureiro, S. J., was born in Lisbon, Portugal, in 1715. From Macao, where he had resided for four years, having previously spent three years in Goa, he was sent on a special mission to Cochinchina in 1742. Finding that missionary activities as such were not in favor there, he entered the service of the King of Cochinchina as mathematician and naturalist.

Loureiro remained in Cochinchina for nearly thirty-six years, with the exception of one short interval (1750-52) when he made a trip to India, being forced to leave Cochinchina because of a violent outbreak of persecution. While in Cochinchina his chief place of residence was its capital city, Hue; hence botanical material from the immediate vicinity of Hue is of

distinctly great importance in connection with any attempt to interpret Loureiro's Indo-China species, for Hue is the classical locality for several hundred species. In December 1777 Loureiro proceeded to Bengal, Pondichery, Macao, and Canton, and at Canton for the next three years he continued his botanical activities, leaving China in March 1781 on his return to Portugal. Bad weather prevented the ship on which he was a passenger from rounding the Cape of Good Hope, forcing its return to Mozambique, whence he finally departed for Lisbon early in 1782. This interruption gave him an opportunity of making certain botanical collections in Mozambique, Zanzibar, and in tropical East Africa. During the remainder of his life he apparently remained in Lisbon, where he died on October 18, 1791.

Loureiro's chief publication, the "Flora Cochinchinensis,"[10] was completed in 1788 and published by the Academy of Science in Lisbon in 1790, two quarto volumes of 744 pages, the pagination continuous. The first part includes the introduction and pages 1 to 354, the second part pages 355 to 744, with one page of errata. The appearance of this work, containing as it did original descriptions of no less than 185 new genera and nearly 1300 species of which about 630 were described as new, created enough of a sensation in European botanical circles that three years later Willdenow[11] issued a second edition of it in Berlin, with the addition of some brief notes. This edition is merely a republication of the original work with a very few minor changes and corrections, no important changes in nomenclature, with some not very important footnotes giving certain reductions, and some suggested alliances. Some of the mutilated type used to indicate certain phonetic values [8] in local names, and some of the special diacritical marks used in the first edition, are eliminated. Like the first edition, it appeared in two volumes with continuous pagination.

While Loureiro's chief publication is this important botanical work, a number of other papers were prepared by him, mostly published after his death in 1791. These are as follows:

Loureiro, J. Memoria sobre o algodão, sua cultura, e fabrica. Mem. Econ. Acad. Sci. Lisb. **1**: 32-40. 1789.

——— Da trasplantaçaõ das arvores mais uteis de paizes remotos. Mem. Econ. Acad. Sci. Lisb. **1**: 152-163. 1789.

——— Da incerteza que ha acerca da origem da Gomma Myrrha. Dá-se noticia de hum arbusto, que tem as mesmas qualidades, e virtudes. Mem. Acad. Sci. Lisb. **1**: 379-387. 1797.

——— Memoria sobre a natureza, e verdadeira origem do Páo de Aguila. Mem. Acad. Sci. Lisb. **1**: 402-415. 1797.

——— Memoria sobre huma especie de petrificaçaõ animal. Mem. Acad. Sci. Lisb. **2**: 47-55. 1799.

——— Exame phisico, e historico. Se ha, ou tem havido no mundo diversas especies de homens? Mem. Acad. Sci. Lisb. **2**: 56-81. 1799.

——— Descripção botanica das cúbebas medicinaes. Mem. Acad. Sci. Lisb. **2**: 82-87. 1799.

——— Consideração phisica, e botanica da planta Aerides, que nasce, e se alimenta no Ar. Mem. Acad. Sci. Lisb. **2**: 88-98. 1799.

[10] **Loureiro, J. de.** Flora Cochinchinensis: sistens plantas in regno Cochinchina nascentes. Quibus accedunt aliae observatae in Sinensi imperio, Africa orientali, Indiaeque locis variis. Omnes dispositae secundum systema sexuale Linnaeanum. i-xx, 1-744 [errata 1]. 1790.

[11] **Loureiro, J. de.** Flora Cochinchinensis . . . denuo in Germania edita cum notis Caroli Ludovici Willdenow. i-xxiv, 1-882. 1793.

——— [Two letters to P. Eckart]: In Hoffler, P. Historia Cochinchinae. 1803.
——— Observationes astronomicae a P. Joanne de Loureiro. Soc. Jesu, in regno Cochinchinae habitae in urbe Sinoae Regis sede. Mem. Acad. Sci. Lisb. **3**(2): 1-6. 1814.

That Loureiro was a man of remarkable attainments is evidenced not only by his published papers, but also by the diverse unpublished manuscripts bequeathed by him to the Academy of Science at Lisbon. Some idea of the extent of these can be gained from Gomes'[12] statement that these consisted of twelve large octavo volumes written on Chinese paper in Chinese characters supposed to consist of a history of Anam; two volumes of drawings representing minerals, plants, and animals; two large volumes containing three hundred ninety-seven colored drawings of plants with their local and Latin names; a "flora iconographica" of Cochinchina written in Anamese; and an Anamese-Portuguese dictionary.

Loureiro, after his return to Portugal, submitted a manuscript entitled "Nova Genera Plantarum" to Sir Joseph Banks in London for publication, but was urged by the recipient to reconsider it in connection with publications of other authors. The English botanists apparently realized that many of the new genera proposed had already been published under other names and were undoubtedly influenced in their recommendations to Loureiro by definite knowledge based on an actual examination of some of his specimens, then in London, that this was the case.

Loureiro had no formal training as a botanist but became interested in the study of plants chiefly from his personal interest in the possibility of using native drugs in the place [9] of those known to and used by Europeans, for of course it was practically impossible for him to secure them in Indo-China. He gained his knowledge of European literature appertaining to drug plants from a copy of one of the numerous Spanish editions of Dioscorides' "Materia Medica" by A. de Laguna. His interest in materia medica naturally attracted his attention to botany, and he gained his first knowledge of the Linnaean system of classification from copies of Linnaeus' "Genera Plantarum," "Systema Naturae," and "Philosophica Botanica"—works which he secured through Thomas Riddell, captain of an English ship at Canton. Captain Riddell also placed Loureiro in correspondence with Sir Joseph Banks in London, which led to his sending an important collection of specimens to London in 1779. In the actual preparation of his "Flora Cochinchinensis," which was finished in Lisbon in October, 1788, he consulted numerous other botanical publications, a bibliographic list of ninety-six titles being appended to the introduction to his work. The volumes most consulted appear to have been Reichardt's edition of Linnaeus' "Systema Plantarum" (1779-80), Rumphius' "Herbarium Amboinense," and Rheede's "Hortus Malabaricus." Gomes' quotation ascribed to Schreber,[13] repeated by an anonymous writer in Broteria **5**: 103. 1906: "Mirandum est sane virum omnibus libris destitutum tam erudite de plantis potuisse judicare," perhaps gives Loureiro somewhat more credit than he himself would claim, because he was not wholly without botanical books.

[12] **Gomes, B. A.** Elogio historico do Padre João de Loureiro. Mem. Acad. Sci. Lisb. Cl. Pol. Mor. Bel.-Let. n.s. **4**(1): 5-6. 1868.

[13] This quotation is really from Willdenow. Fl. Cochinch. ed. Willd. Praefatio III-IV. 1793.

The Scope of Loureiro's and Blanco's Floras

In dealing with such works as Blanco's "Flora de Filipinas" and Loureiro's "Flora Cochinchinensis," one is always at a loss to explain the basis of selection, for the reason that so many common and conspicuous species that obviously must have been familiar to them are not considered. Neither includes many orchids, grasses, sedges, or ferns; yet the regions covered are particularly rich in representatives of these groups. Conspicuous, common, and economically important trees and shrubs are missing in very large numbers. No high-altitude species are considered by either author. In the case of Loureiro it is manifest that he was very greatly influenced by the medicinal or reputed medicinal qualities of the plants that he actually described. He was not particularly interested in plants of little or no economic value, and like Blanco manifestly did not plan his "flora" to be a complete one of the regions covered; and as with Blanco, for reasons of inaccessibility, high-altitude plants were not available to him. Manifestly but a small percentage of Loureiro's species came from the primary forests, but most of them came from the settled and cultivated areas, thickets, and second-growth forests. This is evidenced by the small percentage of endemic species and the large percentage of widely distributed ones among those actually described by him.

On the other hand, Loureiro collected and described certain very conspicuous species that appear in no Indo-China collections made between 1780 and 1927, in spite of the great amount of field work accomplished in that country in the past ninety years. *Bauhinia coccinea* (Lour.) DC. and *Clianthus scandens* (Lour.) Merr. are conspicuous examples of these—plants with masses of showy flowers that would normally not be overlooked by any collector. It is suspected that they are of local occurrence in Indo-China and not species of general distribution. Other species observed and described by Loureiro have not ap-[10]peared in any modern collection. It is highly probable that some of the species, still known only from Loureiro's descriptions and still considered to be of doubtful status, have not been rediscovered by modern explorers. It is manifest that the Hue region in Indo-China is one still worthy of long-continued and intensive botanical exploration, not only in reference to its interesting flora as such, but also regarding still unsolved problems concerning Loureiro's species.

The title "Flora Cochinchinensis" is a somewhat misleading one. Although the percentage of species from Cochinchina is much higher than from any other country, yet several hundred species were described from China and a considerable number from other parts of the Orient, from the Philippines to India and tropical East Africa. The sources of his species are: from Cochinchina alone about 697; from China alone about 254; from Cochinchina and China together about 292; from tropical East Africa 29; from Mozambique 9; from Zanzibar 8; from India 5; from the Malay Peninsula 2; and from the Philippines, Madagascar, and Sumatra 1 each. The problem of interpreting Loureiro's species is thus distinctly more difficult of solution than was the interpretation of Blanco's Philippine species, as the latter author considered only plants from one general and restricted region.

Unfortunately, some authors who have intensively studied the floras of

some of the regions mentioned above failed to realize the desirability of attempting to determine the status of Loureiro's species. The general result is that practically all of the genera and species described by Loureiro in 1790 have been redescribed under other names. In spite of Loureiro's errors of commission and omission, I can see no reason why his names of 1790 should not be accepted in place of those proposed a hundred or more years later for the same species, as long as the earlier names are valid and as long as the identity of the species concerned can reasonably be determined. To me the greater error is the comparatively modern redescription of plants that were already named and well characterized in 1790. In such cases is it logical to accept specific names published since the beginning of the present century for species that were sufficiently well characterized by Loureiro more than one hundred years earlier, which bear specific names that are valid within their respective genera, and which are manifestly identical with the more recently described ones? Here are some illustrative cases:

Tabernaemontana bovina Lour. (*T. tonkinensis* Pitard 1933).
Diospyros lobata Lour. (*D. odoratissima* Lecomte 1928).
Elaeocarpus sylvestris (Lour.) Poir. (*E. decipiens* Hemsl. 1886; *E. glabripetalus* Merr. 1922; *E. kwangtungensis* Hu 1924).
Alchornea rugosa (Lour.) Muell.-Arg. (*A. hainanensis* Pax & Hoffm. 1914).
Glochidion pilosum (Lour.) Merr. (*G. annamense* Beille 1927).
Baccaurea sylvestris Lour. (*B. annamensis* Gagnep. 1927).
Quercus concentrica Lour. (*Q. sabulicola* Hickel & Camus 1921).
Gnetum indicum (Lour.) Merr. (*G. montanum* Marcgr. 1930).
Barringtonia cochinchinensis (Lour.) Merr. (*B. annamica* Gagnep. 1918).
Ardisia loureiriana (G. Don) Merr. (*Rhododendron loureiroianum* G. Don 1834, based on *Azalea punctata* Lour.) (*Ardisia expansa* Pitard 1930).
Desmodium rubrum (Lour.) DC. (*D. carlesii* Schindl. 1920).
Ormosia pinnata (Lour.) Merr. (*O. hainanensis* Gagnep. 1914).
Pueraria montana (Lour.) Merr. (*P. tonkinensis* Gagnep. 1916).
[11] *Ficus simplicissima* Lour. (*F. palmatiloba* Merr. 1928).
Ochna integerrima (Lour.) Merr. (*Discladium harmandii* Van Tiegh. 1902; *Ochna harmandii* Lecomte 1911).
Hedyotis simplicissima (Lour.) Merr. (*H. subdivaricata* Drake 1922).
Gmelina racemosa (Lour.) Merr. (*G. balansae* Dop 1914).
Lindera myrrha (Lour.) Merr. (*Lindera eberhardtii* Lecomte 1913).

The list could be greatly extended, particularly by adding those species renamed and redescribed by various nineteenth century authors who, like some twentieth century authors, failed to recognize that Loureiro had anticipated them.

Various Opinions of Loureiro's Work

Hooker f.[14] makes the following statement regarding Loureiro's work:

"The 'Flora Cochinchinensis' of Loureiro, though it relates to a country beyond our limits, contains so many forms identical with those of Ava and Malaya, that we shall have frequent occasion to refer to it. Father Loureiro, a native of Portugal, resided for thirty-six years in the kingdom of Cochin-China, whither he proceeded as a missionary, but finding that Europeans were not permitted to reside there without good cause, entered the service

[14] **Hooker, J. D. & Thomson, T.** Flora Indica, introductory essay. 46. 1855.

of the King as chief mathematician and naturalist.[15] Though he had no acquaintance with the science of botany, the difficulty of procuring European medicines induced him to direct his attention to native drugs; and with a zeal of which we have unfortunately too few instances, he prosecuted his botanical studies, and so successfully, notwithstanding his want of early education, as to produce a work of standard value. The 'Flora Cochinchinensis' was published at Lisbon, in two volumes quarto, in 1790; a second edition, edited by Willdenow, with a few notes, appeared in octavo, at Berlin, in 1793. As was to be expected, in a work devoted to the botany of a previously unexplored tropical region, the 'Flora Cochinchinensis' contained a great amount of novelty; but the absence of plates, and a defective terminology, caused by a want of familiarity with the labours of other botanists, render the descriptions often obscure, so that a number of the genera described by Loureiro have not yet been identified, while others, not being recognized, have been described as new, and renamed by subsequent botanists."

A. de Candolle,[16] in his discussion of "Descriptions énigmatiques, de groupes naturels," in concluding that Father Velloso, author of the "Flora Fluminensis" (1825) and "Florae Fluminensis Icones" (1827), is the most culpable of botanical authors in the number of genera proposed that were considered to be of doubtful status in 1880, remarks:

"Le Père Blanco est à peu près au même rang, tandis que le Père Loureiro avait eu au moins le mérite d'envoyer en Europe quelques plantes sèches, au moyen desquelles on peut comprendre une partie de ses descriptions. Il est à regretter que ces révérends ecclésiastiques, et même le Père Plumier, leur prédécesseur, ne se soient pas contentés d'écrire des homélies. Bonnes on les aurait lues, mauvaises on les aurait mises de côté; tandis qu'en histoire naturelle l'existence de certains noms et de certaines planches rend nécessaire de consulter indéfiniment les plus mauvais ouvrages."

[12] Hooker also speaks of Blanco's "Flora de Filipinas" as a botanical curiosity and chides him for "his want of acquaintance with scientific works," saying that "so many well-known plants are treated as new, that we consider it undesirable to devote time to their identification." But I can scarcely subscribe to Hooker's opinion as on the whole Blanco's work was better than that of Loureiro, and a distinctly higher percentage of his genera and species have definitely been correlated with those of other authors than is the case with those of Loureiro. Of the twenty-three new genera described by Blanco but one, *Saola,* remains unplaced and only nine of his one thousand one hundred thirty-six species and varieties, of which six hundred and thirty-six were proposed as new, still remain wholly doubtful; that is, doubtful even as to their proper families, while but about forty additional species cannot be placed closer than the genera to which they apparently belong. These reductions have been made, it should be remembered, solely from the published record and in the entire absence of any botanical material prepared by Blanco. As contrasted to the present status of Blanco's genera and species, Loureiro stands about as follows: Four genera based by later authors on Loureiro's descriptions quite unknown; about 23 species that cannot

[15] "He styles himself, in his own narrative, 'rebus mathematicis et physicis praefectum.' "

[16] **Candolle, A. de,** La Phytographie, 141. 1880.

be placed in their proper families; and about 140 additional ones that cannot be correlated with those of other authors, of which about 80 can be placed in their proper genera and about 60 are doubtful as to their generic position. Over 1100 can absolutely be placed as to their species. These figures include all species that Loureiro characterized under binomial names, whether described as new or correctly or erroneously ascribed to Linnaeus, and include 55 cellular cryptogams so inadequately described that only two or three are actually identifiable from the descriptions.

Loureiro's Herbarium Material

Loureiro fortunately prepared some herbarium material, and it is known that he took with him to Lisbon, on his return to Portugal in 1782, representatives of some of the species he described in the form of dried specimens. He had sent several hundred other specimens to Europe some years before his departure from the Orient. It is manifest, however, from Gomes' statement that Loureiro gave little attention to the problem of associating his accepted binomials with his herbarium specimens; nor did he do this consistently with the material he sent to Europe before he left the Orient.

The data given by Gomes in his "Elogio historico do Padre João de Loureiro" under the heading "Os herbarios de Loureiro"[17] are of sufficient importance to warrant their reproduction verbatim, particularly because his lists have apparently been overlooked by all botanists since they were published, and are not available in most botanical libraries. Gomes' paper was read on April 30, 1865, but not published until three years later. It is to a certain degree unfortunate that the data were published in the form presented, in that they contain a number of Loureiro's herbarium names, including various binomials that had previously not been published, none of which, except a few new ones proposed by Desvaux, appear in botanical literature to date. The lists, however, throw much light on Loureiro's methods and clearly bring out the fact that he proposed numerous names that for one reason or another he abandoned in favor of others when he actually did publish his findings. Doubtless some of these generic names were those included in his "Nova [13] Genera Plantarum," the manuscript of which was sent to London from Lisbon, but which was not published.

Gomes lists thirty-seven Loureiro specimens as preserved in Lisbon in 1865, and eighty-seven (not eighty-eight) as preserved in the herbarium of the Muséum d'Histoire Naturelle, Paris. The list of Paris specimens was credited by Gomes to A. L. de Jussieu, but was apparently based on the Desvaux manuscript that is attached to the package of Loureiro specimens in the Paris herbarium; it was copied in Paris for Doctor Gomes by Arthur Morelet.

The quoted statement regarding this material reproduced [in the original publication, pp. 13-19] applies equally to the Loureiro specimens in the herbarium of the British Museum. Probably some botanists would hesitate to accept these Loureiro specimens as actual "types" in the general accepted sense of that word, particularly where Loureiro himself did not add his pub-

[17] **Gomes, B. A.** Mem. Acad. Sci. Lisb. Cl. Pol. Mor. Bel.-Let. n.s. 4(1): 25-31. 1868.

lished binomial to the actual specimen. However, the specimens are at least those that Loureiro prepared to represent his genera and species; many of them bear the local names cited by him; others bear his published Latin names; and most of them doubtless represent material that he actually used in preparing his descriptions. As far as these specimens agree with his published descriptions, and as far as they can be correlated with the latter, my opinion is that they should be accepted as types. Some years ago Doctor F. Gagnepain kindly supplied me with a manuscript list of the Loureiro specimens in the Paris herbarium. In this list ninety specimens are included, but two mentioned by Gomes are lacking, *Phyteuma* = *P. bipinnata* Lour., and *Faskia divaricata* Lour. = *Nerium scandens* Lour. = *Strophantus dichotomus* DC. = *S. caudatus* (Burm. f.) Kurz. Gagnepain, however, lists four species that do not appear in the enumeration as published by Gomes. These are:

Campylus sinensis Lour. = *Tinospora tomentosa* Miers, det. Gagnepain.[18]
Volkameria inermis Lour. [*Clerodendrum inerme* Gaertn.].
Polygonum tataricum Lour. [*Polygonum fagopyrum* Linn.].
Ganosma inodora Lour. = *Gymnema inodorum* Decne., det. Decaisne.

In 1931 Dr. A. C. Smith, of the staff of the New York Botanical Garden, prepared for me photographs of all the Loureiro specimens preserved in Paris which have proved to be of material assistance in elucidating his species. . . . [Gomes' lists follow verbatim in the original publication.]

[19] The most important extant Loureiro collection of botanical specimens is that in the herbarium of the British Museum, Natural History, in London. In a list supplied by that institution, about 228 species are included as being represented by herbarium specimens or checked as being in the herbarium in its copy of Loureiro's "Flora Cochinchinensis," although some of the checked specimens cannot now be located. The Loureiro material, however, is distributed through the large general herbarium, and while it is probable that some of the specimens may have been destroyed, it is also probable that others will eventually be located. These Loureiro specimens, like those in Lisbon and Paris, sometimes bear Loureiro's binomial in his handwriting, sometimes an unpublished manuscript name, sometimes a local name, sometimes no technical name or other data except an annotation to the effect that the specimen was received from Loureiro. The correlation with Loureiro's descriptions, in the case of the indequately labeled specimens, was largely done by Dryander. Many of these types have been critically examined by such botanists as R. Brown, Hiern, Seemann, Pierre, Moore, Britten, Rolfe, Kränzlin, Reichenbach f., Bennett, Miers, Haviland, and others, and some I have personally examined. Wherever published records have been found based on an examination of Loureiro's types, these have been indicated either in the bibliographic references or in the discussions appertaining to the species in question.

In 1774[19] Loureiro sent about sixty specimens from Cochinchina to Europe, a few of these being cited by such authors as Bergius, "Materia

[18] Loureiro's generic description of *Campylus* does not remotely apply to any menispermaceous plant, yet the species description was apparently based on a *Tinospora*, and the Loureiro specimen is a *Tinospora*.

[19] Fl. Cochinch. Introd. XI.

Medica" 5. 1778, and by the younger Linnaeus, "Supplementum" 331. 1781. Yet Doctor R. E. Fries, writing in July, 1919, informed me that he could find no Loureiro specimens in Bergius' herbarium. The Loureiro specimen of *Acosta spicata,* illustrated and described by Swartz (Weber & Mohr Beitr. 1:6. *pl. 2.* 1805) as *Vaccinium orientale* Sw., is not preserved in Swartz's herbarium, and Doctor Samuelsson thinks it probably was based on the specimen in the Banksian herbarium.

In 1779 Loureiro, then in Canton, sent another lot of about 230 specimens to Sir Joseph Banks in London, these being the ones now preserved in the herbarium of the British Museum, Natural History. A few of the extant British Museum specimens, however, are from the herbarium of Robert Brown, and these apparently were received from the Paris herbarium.

[20] Gomes notes Lasègue's[20] statement to the effect that Loureiro's herbarium was preserved in Lisbon in 1845, but throws little or no light on what became of it. He lists thirty-seven specimens as then (1865) preserved in Lisbon, eighty-seven as then preserved in the Museum of Natural History, Paris, and refers to others, the number not indicated, as being preserved in the herbarium of the British Museum. A. de Candolle,[21] writing in 1880, definitely states, on the authority of a letter from Doctor Gomes in Lisbon, that Loureiro's herbarium, being found to be in a bad state of preservation, had been destroyed; this statement probably applies to the remnant of Loureiro's herbarium, i.e., the thirty-seven specimens listed in 1865. The statement received from Paris, repeated by Gomes, merely mentions the fact that the Paris material was secured under particular circumstances and he (Gomes) speaks of it as one of the accidents of war. It is recorded by de Candolle that Geoffroy Saint Hilaire secured eighty-three specimens from Loureiro's herbarium in Lisbon in 1808, which were deposited in the herbarium of the Museum of Natural History, Paris;[22] Gomes lists eighty-seven specimens, but Gagnepain's manuscript list of 1924 gives a total of ninety. This Loureiro material at Paris is preserved as an individual collection, and to the package is attached Desvaux's manuscript enumeration of the species, with numerous reductions indicated by him to which later authors have added others.

Contrasted with Lasègue's statement of 1845 that Loureiro's herbarium, except the small part that was to be found in Paris, was then in Lisbon, is the statement of an anonymous writer in Flora[23] which it seems desirable to quote in full.

"Bekanntlich sind die Systematiker über gar manche von Loureiro in seiner Flora Cochinchianensis [sic] beschriebene Pflanzen nicht im Klaren und nur die Ansicht der Originalexemplare wäre im Stande über dieselben Licht zu verbreiten. Leider scheint alle Hoffnung verloren, die Pflanzen je wieder zu finden. Als nämlich Lissabon durch die Franzosen erobert

[20] **Lasègue, A.** Musée botanique de M. Benjamin Delessert. 323, 348. 1845.

[21] **Candolle, A. de.** La Phytographie. 429. 1880.

[22] French interest in the Loureiro herbarium in Lisbon was possibly due, in part, to the series of papers then being published by A. L. de Jussieu on the relationship of various Loureiroan genera to those described by other authors; see p. 25 [of original].

[23] **Anonymous.** Loureiro's Herbar. Flora 43: 207-208. 1860.

wurde, lies der Marschall Junot nebst anderen botanischen Schätzen die dort aufbewahrt wurden, auch das Herbar Loureiro's einpacken und nach Paris abgehen; den Empfangschein darüber kann man im Lissaboner Naturaliencabinet sehen. Ob die kostbaren Pakete je an den Ort ihrer Bestimmung gelangt sind, darüber hat man durchaus nichts ermitteln können; im Jardin des plantes will man nichts davon wissen, und es ist allerdings sehr möglich, dass jene botanischen Schätze irgendwie auf der Reise vernichtet wurden."

The above statement is definite and categorical, yet it seems strange that Gomes, writing five years later, should have been ignorant of this and should not have known of Marshal Junot's signed receipt for the material which was stated in 1860 to be then extant in Lisbon. This alleged transaction occurred in 1807. Whatever the fate of Loureiro's herbarium, whether destroyed in Lisbon, whether packed for shipment to Paris and lost or destroyed in transit, the fact remains that of about 1300 species described by him, less than one-fourth are now represented by extant types. The internal evidence is that the [21] entire Loureiro herbarium consisted only of the specimens now preserved in Paris, and the small remnant that was retained in Lisbon, and that Loureiro actually prepared specimens only of those which he sent to Europe in 1774 and 1779, and about 127 specimens that he took with him on his return voyage to Lisbon; the total would be slightly over 400 specimens of which apparently about 100 have, for one reason or another, been lost or destroyed. This conclusion is based on the facts that of the 227 species listed in the British Museum copy of Loureiro's "Flora Cochinchinensis" all but 2 or 3 are from Indo-China, i.e., those specimens actually sent by Loureiro from Canton in 1779; of the 90 in the Paris herbarium about 80 are from China, 7 from Africa and only 4 from Indo-China; and of the 37 listed by Gomes as being formerly preserved in Lisbon, 33 are from Indo-China, and one each from China, Africa, Sumatra, and Madagascar. The Paris collection then represents for the most part those specimens actually prepared by Loureiro after he arrived in Canton in 1778. The small Lisbon collection probably represents the special herbarium mentioned by Almeida[24] as having been presented to the botanical garden at Ajuda in 1789. There then seems to be no warrant for charging the French with having taken more than the 90 specimens listed above [p. 15 of original]. The difference between the contents of the "Paris" collection and that of the smaller "Lisbon" one, as to origin, would seem to indicate two different collections, the first almost wholly of Chinese plants, the second mostly of Indo-China ones.

Almeida[25] himself states regarding the herbaria at the botanical garden at Ajuda: "O antigo museu da Ajuda, apesar da pobreza em herbários, que lá foi encontrar—desfalcados não só pela invasão francesa, mas principalmente pelo abandono da su conservação." On page 234 of the same work in discussing certain old accession records of the botanical garden at Ajuda which he saw in the home of Doctor Alves de Sá, he quotes the following: "João Loureiro deu, no ano de 1789, um pequeno herbário de Plantas da Cochinchina, algumas sementes das ditas, utensílios vários e

[24] **Almeida, J. de.** O Dr. Frederico Welwitsch e a sua obra em Angola **1: 207-208** [no date].

[25] **Almeida, J. de.** *l.c.*

móveis domésticos daquele País." It is highly probable that the Loureiro specimens actually listed by Gomes [page 14] were those in this small herbarium, and that this herbarium was independent of the one presented by him to the Academy of Science, and which was taken to Paris by the French in 1807 or 1808.

In view of the fact that the value of the Loureiro specimens was not appreciated in Lisbon, and that they apparently were destroyed some time before 1874, the fact that an important part of the herbarium was transmitted to Paris in 1807 or 1808, where the value of the material was appreciated, may be looked upon as one of the fortunate accidents of war.

Mr. Achilles Machado, Secretary of the Academy of Science of Lisbon, in answer to my enquiry, courteously supplied the following information under date of April 20, 1932. Mr. Machado secured his information from Prof. José Joaquim de Almeida, who supplied the following data:

"At the time when Bernardino Gomes, the younger, wrote his eulogy on Loureiro in 1865, the Botanical Garden and the Museum of the Academy of Science at Ajuda, about eight kilometers from Lisbon, had been a part of the Polytechnical School since 1839, but the herbarium was not actually transferred to the Polytechnical School until 1874. It is [22] certain that Gomes' statements were based on documents rather than on an examination of the material he mentions, as the Conde de Ficalho in charge of the Botanical Section of the Polytechnical School inspected the herbarium of the Museum of the Academy of Science in 1874 and stated that it was then in poor condition, partly because of the material removed by the French, but principally because of the practical abandonment of the collection; that is, the herbarium had not been properly cared for. He mentions Ferreira's Amazon collections but says nothing about those of Loureiro. Thus the thirty-seven Loureiro specimens mentioned by Gomes were not transferred to the Polytechnical School as they had apparently deteriorated so badly at Ajuda as to be valueless, and had apparently been discarded before 1874. The 397 colored drawings of the iconographic flora of Cochinchina written in the native language, bequeathed to the Academy by Loureiro with other manuscripts, are not at the Polytechnical School, and no longer exist at the Academy. I saw some of the drawings at the home of Dr. Alves de Sá, a son of the Visconde de Alves de Sá, nephew of Dr. José de Sá dos Santos Vale, who was Director of the Museum and of the Botanical Garden at Ajuda in 1834-35 . . . "

Mr. de Almeida concludes that the thirty-seven Loureiro specimens listed by Gomes are no longer extant, were not extant in 1874, and that the only specimens that were saved to science from the Loureiro collections of the Museum of the Academy of Science are those that were transferred to Paris in 1807 or 1808.

While in the discussion of the individual species I have generally mentioned those that are represented by extant Loureiro specimens in London and in Paris, I have not thought it worth while to so mention the thirty-seven Lisbon specimens listed by Gomes as they no longer exist.

Loureiro's name looms large in the annals of systematic botany because of the large number of genera and species described by him as new; because

of the very numerous unsolved problems as to the status of his genera and species and their relationship with those described by other botanists; and because of the same problems in relation to the larger number of binomials and many new generic names proposed by his successors but based on his original descriptions. In somewhat over eighty binomials the specific name is derived from Loureiro and six generic names have been proposed in his honor. These are:

Lourea Necker (1790). A valid genus of the Leguminosae.
Loureira Raeuschel (1797) based on *Schrebera* Retzius, and a synonym of *Elaeodendron* Jacquin; not based on any Loureiroan genus or species.
Loureira Cavanilles (1799) a synonym of *Gatropha* Linnaeus; not based on any Loureiroan genus or species.
Loureira Meisner (1837) based on *Toluifera cochinchinensis* Lour. and a synonym of *Glycosmis* Correa.
Lourya Baillon (1887), a synonym of *Peliosanthes* Andrews; not based on any Loureiroan genus or species.
Neolourya Rodriguez (1934); not based on any Loureiroan genus or species.

Publications or commentaries on Loureiro's "Flora Cochinchinensis" as to the entire work do not exist, although most of his species have been considered by other authors in the 144 years that have elapsed since the work was published. Most of these post-Loureiroan references are merely repeated or abstracted descriptions and add little to our knowledge [23] of the individual species described; in fact, many of the authors following Loureiro have complicated rather than simplified the situation through proposing 54 new generic names and about 750 new binomials based on Loureiro's often more or less imperfect and incomplete descriptions, rarely supplemented by an examination of an authentic specimen. These names were proposed by such authors as Blume, Cambessèdes, A. Chevalier, Choisy, Dietrich, G. Don, Hooker & Arnott, A. L. de Jussieu, O. Kuntze, Nees, Persoon, Pierre, Poiret, Raeuschel, Rafinesque, M. Roemer, Roemer & Schultes, Sprengel, Steudel, Vahl and many others. Various authors, such as Baillon, Britten, Bunting, Gagnepain, Koenig, Moore, R. Brown, Seemann, Mueller-Arg., Tandy, A. de Candolle, Swartz, and others, have published more extended descriptions or critical notes based on the extant Loureiro specimens in London and Paris.

Special Publications on Loureiro's Work

To prepare a complete bibliography of all works in which Loureiro's genera and species appear, would be a very heavy task and one that would serve no useful purpose, as references to Loureiro are found in all standard works and monographic treatises dealing with families or genera with which Loureiro was concerned, and in all or most standard works dealing with the floras of British India, Indo-China, China, Japan, Malaysia, the Philippines, Australia, Polynesia, and tropical Africa. References to Loureiro are scattered through the voluminous periodical literature and independent treatises from shortly after 1790 to the present date, while a considerable number of special articles have been published on the identity of certain genera and species proposed by Loureiro, some of these papers being based on an examination of extant types, and others based on a study of Loureiro's descrip-

tions with or without reference to material from the classical localities. A bibliography of this type of literature, including some biographical references follows [in the original publication].

[28] In many of the descriptions of Loureiro's species appearing in standard monographic works, except in the case of those whose status is well understood, nothing is added to the original descriptions which are often more or less imperfect or incomplete, and frequently inaccurate. In some cases monographers have taken great pains to search for the extant types in Paris and in London, and have published amplified and corrected descriptions based on these original specimens. In other cases, amplified descriptions have been based on collections made since Loureiro's time, which can, with a fair degree of certainty, be taken to represent the actual species Loureiro had in mind. In still other cases later authors have interpreted some of Loureiro's descriptions from such data as he gave, and have prepared amplified descriptions of what they took to represent the same species but based on material originating from places remote from the classical localities; and in some cases such descriptions do not apply to the form that Loureiro actually attempted to describe. In other words, Loureiro's specific names are sometimes currently applied to forms more or less remote from the original type, on the basis of a misinterpretation of the original description.

Loureiro's Genera

Loureiro described 185 new genera. Of these, up to 1919, fourteen had never been placed and remained as *genera incertae sedis,* some not even having been placed within their proper families. To this list should be added a considerable number of generic names proposed by later authors but typified by Loureiro's descriptions which have not satisfactorily been placed. From data published within the past few years by various authors, based on Loureiro's extant types, and supplemented by a study of Loureiro's descriptions, this list of doubtful genera in both categories has been reduced to four, i.e., *Agonon* Raf., *Isgarum* Raf., *Silimanus* Raf. and *Pseudiosma* A. Juss.

Wherever Loureiro's generic names, although older than those proposed by other [29] authors for the same groups, have been eliminated in favor of more recent names in the approved list of *nomina generica conservanda,* the conserved name has here been adopted and Loureiro's name placed as a synonym. . . . [A list of Loureiro's new genera follows in the original publication.]

[33] An examination of this list brings out certain interesting facts. Of the 185 genera proposed and described by Loureiro as new in 1790, about 115 had already been characterized by other authors under other names previous to 1790. About forty of Loureiro's generic names are valid under all rules of botanical nomenclature. If strict priority be followed as to Loureiro's generic names, where his name was the first one proposed for the group in question, about 64 would be accepted. Thus *Phyllodes* Lour. would replace [34] *Phrynium* Willdenow (1797); *Columella* Lour. or *Lagenula* Lour. would replace *Cayratia* A. L. de Jussieu (1823); *Dasus* Lour. would replace *Lasianthus* Jack (1823); *Botria* Lour. would replace *Ampelocissus*

Planchon (1887); *Polia* Lour. would replace *Polycarpaea* Lamarck (1792); *Campylus* Lour. (1790) might replace *Tinospora* Miers (1851); *Baryxylum* Lour. would replace *Peltophorum* Walpers (1842); *Aulacia* Lour. would replace *Micromelum* Blume (1825); *Bembix* Lour. would replace *Ancistrocladus* Wallich (1832); *Melodorum* Lour. would replace *Mitrephora* Hooker f. & Thomson (1855); *Barbula* Lour. would replace *Caryopteris* Bunge (1835); *Diphaca* Lour. would replace *Ormocarpum* Beauvois (1806); *Sarcodum* Lour. would replace *Clianthus* Banks & Solander (1832); *Placus* Lour. would replace *Blumea* de Candolle (1832); *Ceraia* Lour. or *Callista* Lour. would replace *Dendrobium* Swartz (1799); *Rhaphis* Lour. would replace *Chrysopogon* Trinius (1820); *Polychroa* Lour. would replace *Pellionia* Gaudichaud (1826); *Vanieria* Lour. would replace *Cudrania* Trécul (1847); *Phyllaurea* Lour. would replace *Codiaeum* A. L. de Jussieu (1824); *Pselium* Lour. would replace *Pericampylus* Miers (1851); *Pedicellia* Lour. would replace *Mischocarpus* Blume (1825), and *Triceros* Lour. would replace *Turpinia* Ventenat (1803); of these *Campylus* and *Turpinia* are not yet included in the lists of *nomina generica conservanda.*

Furthermore, the following Loureiroan genera are older than those in the conserved lists, but in each case there are still older generic names for each group; *Cylindria* Lour. would replace *Linociera* Swartz (1791), except for the older *Mayepea* Aublet (1775); *Eystathes* Lour. would replace *Xanthophyllum* Roxb. (1814, 1819), except for the earlier *Pelae* Adanson (1763); *Tralliana* Lour. would replace *Colubrina* L. C. Richard (1827), except for *Marcorella* Necker which was also published in 1790; *Diatoma* Lour. would replace *Carallia* Roxburgh (1814), except for the older *Karekandel* Adanson (1763); *Diceros* Lour. would replace *Limnophila* R. Brown (1810), except for the older *Ambulia* Lamarck (1783); *Grona* Loureiro would replace *Desmodium* Desvaux (1813), except for the earlier *Meibomia* Adanson (1763); and *Nephroia* Loureiro would replace *Cocculus* de Candolle (1818), except for the earlier *Cebatha* Forsk., *Leaeba* Forsk., and *Epibaterium* Forsk. (1776). On a very strict interpretation of types *Derris* Lour. is actually a synonym of *Dalbergia* Linnaeus f. (1781).

As this study has been consummated under the general provisions of the International Code of Botanical Nomenclature, I have accepted the conserved names approved by the Vienna, Brussels, and Cambridge Botanical Congresses, even where, in my personal opinion, some of these should not have been included.

Of Loureiro's 185 new genera there are only seven cases where exactly the same groups have not been designated and described under other generic names. One hundred fifteen of these had been characterized and named by other botanists before 1790, a reflection on Loureiro's bibliographic work. Sixty-three were given new names by later authors chiefly for the reason that Loureiro's contemporaries and successors failed to realize that the groups they named and described as new after 1790 had already been named and characterized by Loureiro, a reflection on the bibliographic work of the later botanists. These seven genera are *Lasia, Triphasia, Thylachium, Centipeda, Blastus, Knema,* and *Limacia,* and for two of these variant spellings have been proposed. Loureiro's successors, notably Rafinesque, proposed 54 additional new generic names, all based wholly or in part on

Loureiro's [35] original descriptions. . . . [A list of these with their reductions as far as their status could be determined follows in the original publication.]

[38] Of these 54 generic names, based wholly or in part on Loureiro's published descriptions, except *Hisutsua* DC. which was based on an authentic specimen of *Matricaria cantoniensis* Lour., a few remain that are still of doubtful status, doubtful even as to the family to which they belong. I have been unable to place *Callicarpa umbellata* Lour. on which *Agonon* Raf. is wholly based; *Isgarum* Raf., based wholly on the description of *Salsola didyma* Lour., is doubtful as to its family but is possibly a representative of the Chenopodiaceae; *Pseudiosma* A. Juss., based on the description of *Diosma asiatica* Lour., remains unplaced as to its family, and *Silamnus* Raf., based on the description of *Cephalanthus procumbens* Lour., is in the same category as *Agonon, Pseudiosma,* and *Isgarum.*

Thus out of 54 new generic names proposed by Loureiro's successors 4 remain as of entirely doubtful status, yet all of the 185 named and described by Loureiro as new have been placed with sufficient accuracy either as valid genera or as synonyms of those described by other authors.

Loureiro's Treatment of Linnaean Genera

In his interpretation of many Linnaean genera, Loureiro made numerous grave errors, ascribing to certain generic names species totally unrelated to the groups as defined by Linnaeus. In other cases he was correct in the interpretation of certain Linnaean binomials, both as to the genus and the species, but was totally wrong as to generic positions of other species that he placed in the same group, as illustrated by *Juglans.* Of the three species described, *J. regia* is a form of the Linnaean species; *J. camirium* is the euphorbiaceous *Aleurites moluccana* Willd.; and *J. catappa* is the combretaceous *Terminalia catappa* Linn., but Loureiro's binomial in this case was not based on the earlier one of Linnaeus.

As illustrations of absolute errors in the interpretation of Linnaean genera there may be cited: *Euonymus* (Celastraceae), one species, *E. chinensis* Lour. = *Gymnopetalum cochinchinense* (Lour.) Kurz (Cucurbitaceae); *Primula* (Primulaceae), two species, *P. mutabilis* Lour. = *Hydrangea opuloides* (Lam.) K. Koch (Saxifragaceae), the other, *P. sinensis* Lour., a species of entirely doubtful status but no primulaceous plant; *Plectronia* (correctly Oliniaceae, not Rubiaceae), one species, *P. chinensis* Lour. = *Acanthopanax trifoliatus* (Linn.) Merr. (Araliaceae); *Crassula* (Crassulaceae), one species, *C. pinnata* (non Linn.) = *Eurycomia longifolia* Jack (Simarubaceae); *Santalum* (Santalaceae), one species, *S. album* (non Linn.) = *Dysoxylum loureiri* Pierre (Meliaceae); *Thuja* (Pinaceae), one species, *T. orientalis* (non Linn.) = *Glyptostrobus pensilis* (Abel) K. Koch (Pinaceae); *Reseda* (Resedaceae), two species, *R. chinensis* Lour. and *R. cochinchinensis* Lour., both = *Hypericum japonicum* Thunb. (Guttiferae); *Toluifera* (Leguminosae), one species, *T. cochinchinensis* Lour. = *Glycosmis cochinchinensis* Pierre (Rutaceae); *Melanthium* (Liliaceae), one species, *M. cochinchinense* Lour. = *Asparagus cochinchinensis* (Lour.) Merr. (Liliaceae); *Cedrela* (Meliaceae), one species, *C. rosmarinus* Lour. = *Baeckea frutescens* Linn. (Myrtaceae); *Juncus* (Juncaceae), one species, *J. bulbosus* Lour. = *Eleusine indica* Gaertn. (Gramineae), while a true *Juncus, J. effusus* Linn., was described as *Scirpus capsularis* Lour.; *Actaea* [39] (Ranunculaceae), one species, *A. aspera* Lour. = *Tetracera scandens* (Linn.) Merr. (Dilleniaceae); *Ervum* (Leguminosae), one species, *E. hirsutum* (non Linn.) = *Flemingia macrophylla* (Willd.) O. Ktz. (Leguminosae); *Lantana* (Verbenaceae), one species, *L. racemosa* Lour. = *Gmelina racemosa* (Lour.)

Merr. (Verbenaceae); *Penaea* (Penaeaceae), two species, one *P. nitida* Lour. = *Gluta nitida* (Lour.) Merr. (Anacardiaceae), the other *P. scandens* Lour., status unknown; *Gardenia* (Rubiaceae), one species, *G. volubilis* Lour. = *Ichnocarpus volubilis* (Lour.) Merr. (Apocynaceae); *Hottonia* (Gentianaceae), one species, *H. litoralis* Lour. = *Catharanthus roseus* (Linn.) G. Don (Apocynaceae); *Varronia* (Boraginaceae), one species, *V. sinensis* Lour. = *Cordia dichotoma* Forst. f. (Boraginaceae), the same species also described as *Argyreia arborea* Lour. (Convolvulaceae); *Phyteuma* (Campanulaceae), two species, *P. bipinnata* Lour. and *P. cochinchinensis* Lour., both = *Sambucus javanica* Reinw. (Caprifoliaceae); *Scabiosa* (Dipsacaceae), one species, *S. cochinchinensis* Lour. = *Elephantopus scaber* Linn. (Compositae); *Bobartia* (Cyperaceae), one species, *B. indica* (non Linn.) = *Rynchospora wightiana* Steud. (Cyperaceae); *Anthoxanthum* (Gramineae), one species, *A. pulcherrimum* Lour. = *Centotheca latifolia* (Osb.) Trin. (Gramineae); *Phleum* (Gramineae), one species, *P. cochinchinense* = *Ophiurus cochinchinensis* (Lour.) Merr. (Gramineae); *Ischaemum* (Gramineae), one species, *I. importunum* Lour. = *Panicum repens* Linn. (Gramineae); *Gaura* (Onagraceae), one species, *G. chinensis* Lour. = *Haloragis chinensis* (Lour.) Merr. (Haloragaceae); *Anagyris* (Leguminosae), one species, *A. foetida* Lour. = *Sophora japonica* Linn. (Leguminosae); *Salvadora* (Salvadoraceae), two species, *S. biflora* Lour. and *S. capitulata* Lour., both = *Streblus asper* Lour. (Moraceae); *Coccoloba* (Polygonaceae), two species, *C. cymosa* Lour. and *C. asiatica* Lour., both = *Polygonum chinense* Linn. (Polygonaceae); *Vateria* (Dipterocarpaceae), one species, *V. flexuosa* Lour. = *Mischocarpus flexuosus* (Lour.) Merr. (Sapindaceae); *Pistacia* (Anacardiaceae), one species, *P. oleosa* Lour. = *Schleichera oleosa* (Lour.) Merr. (Sapindaceae); *Digitalis* (Scrophulariaceae), two species, *D. sinensis* Lour. = *Adenosma glutinosum* (Lour.) Druce, and *D. cochinchinensis* Lour. = *Centranthera cochinchinensis* (Lour.) Merr. (Scrophulariaceae); *Ruellia* (Acanthaceae), two species, *R. antipoda* Linn. = *Ilysanthes antipoda* (Linn.) Merr. (Scrophulariaceae), *R. ciliaris* (non Linn.) = *Torenia peduncularis* Benth. (Scrophulariaceae), and *Elaeocarpus* (Elaeocarpaceae), one species, *Elaeocarpus integerrimus* Lour. = *Ochna integerrima* (Lour.) Merr. (Ochnaceae).

It is noted from an examination of the preceding data that a high percentage of Loureiro's new genera had already been described under other names previous to 1790. From the last discussion it will be correctly inferred that Loureiro's attempts to interpret the genera of other authors must be looked on with suspicion as to their correctness, and consequently all his descriptions, good and bad, must be critically scanned. As it is thus clear that in many cases his interpretations of Linnaean genera cannot be trusted; likewise it is found that very frequently little trust can be placed in his assignment of his new genera to the Linnaean classes and orders, as it is not infrequently found that they represent units remote from the major Linnaean groups in which he placed them.

Loureiro's Species

An examination of Loureiro's work shows that he frequently described the same species twice and sometimes three or even four times, often under different generic names, as did Blanco in his "Flora de Filipinas." This was due in part to his putting too much faith [40] in the sexual system of classification of Linnaeus, not realizing that the number of stamens and carpels often vary in the same species; partly due to his failing to recognize that a fruiting specimen placed in one genus actually represented the same species as a flowering specimen placed in some other group; partly to his placing staminate specimens of dioecious species in one genus, and pistillate specimens of the same species in another genus; partly to his treatment of

slightly different forms of the same species, particularly in the case of cultivated plants, as representing distinct species; and undoubtedly in large part because he did not consistently preserve herbarium material for purposes of comparison, therefore being obliged to rely too much on his own memory. Of the 1292 species described it has been possible to make about 135 reductions to those otherwise described in the same work, so that the total number of distinct species considered in the "Flora Cochinchinensis" would at most be but about 1157.

In his interpretation of Linnaean genera he made numerous grave errors as noted above, and in interpreting Linnaean species he was wrong in about 374 out of 663 cases, his error of interpretation in the case of species being slightly over 56 per cent, as compared with Blanco's misinterpretation of approximately 60 per cent of the species ascribed to Linnaeus in the "Flora de Filipinas." In all cases of misinterpretation on the part of Loureiro, as with Blanco, the specific names are considered to be invalid; any other treatment of them is not only illogical, but would entail a very large number of changes in accepted binomials for well-known species which it is otherwise unnecessary to make.

It seems to be evident, from a study of Loureiro's descriptions that at some time he had actual specimens in practically every case, either when he prepared his notes or when he wrote the final description. Many of the descriptions are excellent, in fact distinctly superior to those of many of those prepared by Loureiro's contemporaries in Europe. In other cases they are short, incomplete, indefinite, and sometimes very inaccurate. He admits, in some cases, that data were added partly from memory and, occasionally, that certain data were taken from illustrations in Chinese medical books. Many of his most unsatisfactory descriptions are manifestly based on fragmentary or incomplete specimens, and most of such material was certainly secured by him from Chinese herbalists or dealers in medicinal plants. In some cases his descriptions are in part based on such material as he had for examination, in part on the Linnaean descriptions cited, and, in a few cases, in part on the pre-Linnaean illustrations that he thought represented the species he had in hand. That he actually had specimens of some kind in most cases is evidenced by the fact that he cites Anamese and Chinese names for nearly all of the Indo-Chinese and Chinese plants described. It is obvious, from a most cursory examination of his work, that in many cases where he cites illustrations in Rheede's "Hortus Malabaricus" and Rumphius' "Herbarium Amboinense" as representing his species, he gravely erred, the illustrations sometimes appertaining to genera and species totally different from those he actually described. In no case can a Loureiroan species be actually typified by a cited pre-Linnaean illustration, even, as in the case of some of the references to Rumphius, where Loureiro took his specific name from Rumphius for the plant he actually described, as his descriptions sometimes apply not only to plants in different genera from those represented by Rumphius, but even in different families, as illustrated by *Thysanus palala* Lour. = *Cnestis palala* (Lour.) Merr. (Connaraceae); but *Palala secunda* Rumph., whence Loureiro took his specific name, is the myristicaceous *Horsfieldia sylvestris* Warb

[41] The errors that Loureiro made in misinterpreting pre-Linnaean descriptions and illustrations were due to conditions under which he worked and are no worse than similar ones made by Linnaeus himself, as well as by Loureiro's contemporaries and immediate successors; in fact a considerable number of Loureiro's errors in placing pre-Linnaean descriptions and illustrations were merely copied from Linnaeus' works.

Hooker [p. 253 (11)] has already noted the faulty terminology used by Loureiro, a fact that renders the correct interpretation of some of his genera and species peculiarly difficult. That he did not use certain technical terms in the same sense as did his contemporaries must constantly be kept in mind. The difficulties are further enhanced by the fact that Loureiro's descriptions are frequently general rather than definite, and almost never are they comparative; measurements are rarely given; certain characters that are now deemed to be essential in diagnoses of new species were not considered to be of sufficient importance even to note; he is not definite in many cases in distinguishing between simple and compound leaves, alternate and opposite ones, inferior and superior ovaries, and free or united petals. It is a well-known fact that can be proven by an examination of Loureiro's extant types, that in many cases his descriptions of both genera and species are erroneous—not because Loureiro deliberately erred but because he seriously misinterpreted various morphological characters.

In some cases it is certain that Loureiro had only flowering specimens, and yet, particularly in those cases where he placed his species in Linnaean genera, he described the fruits in general terms. This usually does not mean that his descriptions were based on material from two unrelated species and that therefore the name should be ignored on the specious claim that the species was based on a mixture of material, *but rather that Loureiro deliberately added generalized fruit characters to make his description conform to the characters of the Linnaean genera in which the species were erroneously placed.* A manifest case of many of this type is represented by the supposedly rubiaceous *Gardenia volubilis* Lour. = *Ichnocarpus volubilis* (Lour.) Merr. of the Apocynaceae, where fortunately we are sure of what Loureiro intended, as his type, a flowering specimen, is still extant.

In other cases his descriptions are based on material originating from unrelated plants, a notable example being the genus *Baryxylum,* based on flowers of one species (a *Peltophorum*), the fruits of one, perhaps two, unrelated genera (*Gymnocladus, Intsia*), and possibly the leaves of a third genus, if we may trust the specimens in the herbarium of the British Museum received from Loureiro. *Aloexylum agallochum* Lour. was based in part on plants that are apparently identical with *Aquilaria àgallocha* Roxb. of the Thymelaeaceae, and in part on some leguminous tree. *Convolvulus mammosus* Lour. is in part *Ipomoea batatas* Poir. and in part *Dioscorea esculenta* (Lour.) Burkill. The description of *Equisetum arvense* Linn. was based in part on material apparently representing that species, in part, and as to its Chinese name and uses, on *Ephedra sinica* Stapf.

There are a few remaining genera of doubtful status that were based by later authors on various species described by Loureiro. These are *Agonon, Isgarum,* and *Silamnus* of Rafinesque, and *Pseudiosma* A. Jussieu. They

unquestionably represent known groups described by other botanists under other names. They remain unrecognizable either because of the misinterpretation of essential morphological characters, errors of observation in preparing the descriptions and thus errors in fact, incomplete data, or because the description of what was taken to represent a single species was actually based on material [42] representing different and perhaps not even closely related ones. The same comments also apply to most or all of the remaining species that have as yet not been accurately placed as to their proper families and genera.

Taxonomists working in Europe and America, without a first-hand knowledge of the flora of such a region as Indo-China, do not always realize that the bulk of the material examined by the early pioneers in the oriental tropics, whether from India, Ceylon, Java, the Philippines, or Indo-China, came from low altitudes in the immediate vicinity of settlements and not from the more remote primary forests of the interior, as the latter regions were relatively inaccessible in the early years of European exploration and colonization. A high percentage of all botanical material collected in the settled areas at low altitudes in the Old World tropics invariably consists of common, widely distributed, well-known species rather than of local endemics. Thus the flora of Kwangtung Province, especially in the general vicinity of Canton whence Loureiro secured most of his Chinese material, is distinctly well known. It is certain that there has been no radical change in the nature and constituent species of this flora during the past 150 years, except in the naturalization of plants introduced within the period indicated; yet a number of binomials and some generic names based by Loureiro or his successors on Canton material remain of wholly doubtful status. These I have not been able to determine even by the tedious process of elimination, simple forms of which are illustrated by the following cases. By examining the description critically and then scanning the list of all species known from Kwangtung Province, the problem of the identity of *Drosera umbellata* Lour. was easily solved; the only known Kwangtung species in any family that conforms at all to the characters of *Drosera umbellata* Lour. is *Androsace saxifragifolia* Bunge, and as early as 1848 Planchon had indicated that Loureiro's species was an *Androsace*. A comparison of Loureiro's description with specimens of Bunge's species from Canton shows conclusively that the two species are identical. No botanist has ever suggested a reduction of *Gaura chinensis* Lour. which from the description is manifestly not a *Gaura*. By application of the method of elimination this proves to be the same as *Haloragis scabra* Benth.; Loureiro's description is an admirable one for this plant. *Antidesma scandens* Lour. similarly considered proves to be staminate *Humulus japonicus* Sieb. & Zucc., quite as *Salvadora biflora* Lour. and *S. capitulata* Lour. prove to be no other than the genus and species described by Loureiro himself as *Streblus asper*. In other cases the application of this method gives no productive results, and here I am forced to the conclusion that Loureiro's descriptions are erroneous in certain essential details. In such instances it is exceedingly difficult to differentiate between the accurate and inaccurate parts of a single description. Loureiro's published descriptions, therefore, like Blanco's, must be interpreted rather than always accepted as strictly accurate.

Many botanists have not realized that in a high percentage of the descriptions published by such authors as Loureiro and Blanco technical errors occur, due to misinterpretation of morphological characters, errors of observation, errors in transcription, and other causes. The bibliographic botanist has been prone to coin new binomials, and to make numerous transfers of specific names because of discrepancies noted in comparing published descriptions. Most of the new generic names and a high percentage of the new binomials typified by Loureiro's descriptions can thus be accounted for. The changes were for the most part proposed in good faith, but frequently without a clear understanding of the situation. Thus both Loureiro and Blanco described *Polyozus* as having *bipinnate leaves;* [43] in both cases they had specimens of the rubiaceous genus *Canthium,* and misinterpreted the distichously arranged branchlets and the distichously arranged leaves as representing *bipinnate leaves,* not an unnatural interpretation as those who are familiar with *Canthium* in the field will testify; both rather frequently described branchlets with distichously arranged simple leaves as *pinnate leaves,* again not at all an unnatural error. In other cases in species having pinnate leaves the compound character is not mentioned and the leaves are described, at least by inference, as simple. Because Blanco (Fl. Filip. 9. 1837) described *Nyctanthes sambac* as having *pinnate leaves,* Hasskarl 27 years later proposed the new binomial *Jasminum blancoi* for it; assuming that Blanco's description was technically correct, the species could not be *Nyctanthes sambac* Linn. which has simple leaves, hence the new name. But Blanco merely misinterpreted the branchlets with their characteristic distichously arranged leaves as representing a *pinnate leaf.* As late as 1932 we find Doctor Kobuski[33] taking exception to my reduction of *Jasminum blancoi* Hassk. (*Nyctanthes sambac* Blanco) to *Jasminum sambac*.Ait. because he did not realize that Blanco's description of the leaves as pinnate was false. He overlooked the fact, as Hasskarl did, that Blanco himself (Fl. Filip. ed. 2, 6. 1845) noticing his own error eliminated the reference to pinnate leaves in his description (1845) of *Nyctanthes sambac!* But here again, one familiar with the Philippine flora would have been on his guard, for *sampagita* is an absolutely fixed and unvarying name in the Philippines, universally applied to the widely cultivated *Jasminum sambac* Ait. and never applied to any other plant; it is just as fixed a name for *Jasminum sambac* in the Philippines as is hawthorn for *Crataegus oxyacantha* Linn. in England, or mayflower for *Epigaea repens* Linn. in New England; and no matter how inaccurate, incomplete, or otherwise unsatisfactory Blanco's description may have been, the local name itself would definitely place the species. Yet Doctor Kobuski suggests that *Jasminum blancoi* Hassk. (*Nyctanthes sambac* Blanco) must be a species of *Jasminum* in the group with *J. grandiflorum* Linn., a group unrepresented in the Philippines by either native or, in Blanco's time, introduced species!

Should a genus or species be eliminated merely because such errors are present in the original description? Personally I think not. I would no more eliminate a Loureiroian or Blancoan species because its original description contained palpable errors due to false interpretations of mor-

[33] Journ. Arnold Arb. **13**: 172. 1932.

phological characters, than I would eliminate *Volkameria japonica* Thunb. which Thunberg described as a large tree, although it is actually only a small shrub. The logical action in such cases would seem to be the retention of the name, if the name be a valid one for a recognized species, with a proper correction of the error or errors contained in the original description.

The Bearing of Local Names on the Interpretation of Loureiro's Species

Some of Loureiro's Chinese descriptions were based on material from northern China and one at least on material as far west as Yunnan. Many of the descriptions based on specimens reported to have come from parts of China never visited by Loureiro are peculiarly imperfect, indefinite, or even inaccurate, and were manifestly based on more or less broken and fragmentary material secured from herbalists. The various Indo-China-China species which can definitely be placed from Loureiro's descriptions, and which do not grow as far south as Indo-China, were likewise based on specimens secured from herbalists, [44] material imported into Indo-China from China, just as the Chinese today import their own drug plants into Singapore, Manila, San Francisco, New York, or any other city where large colonies of Chinese exist.

It seems probable that in some, perhaps many cases, he erred in citing Chinese names and in recording the reputed uses of certain species described. It is suspected that many of the Chinese names, even those compiled at Canton, are really Mandarin; some, however, are definitely Cantonese.

Loureiro's own field work in Kwangtung was strictly limited, as he was not permitted to proceed beyond the suburbs of the city of Canton. He definitely states (Fl. Cochinch. Introd. XI) that much of his botanical material was brought to him by the Chinese. His statements regarding Chinese species as to the size of the plants, if other than small herbs, their habits and habitats, must be interpreted with this fact in view; that is, that Loureiro in many cases never saw the plants growing in nature but had merely branches or branchlets and had to depend on hearsay evidence for certain data.

He realized, and so stated, that the Chinese names cited by him in many cases were untrustworthy. Here, as in other countries, local names for those species of distinct economic importance are much more constant and more to be trusted than are the vernacular names of numerous small herbs, grasses, sedges, weeds, and other plants of little use in the economy of the natives.

In Loureiro's text Anamese names are indicated by α, Chinese by β, African by γ, and Indian by δ. New genera and species are indicated by the conventional sign †. It is unfortunate that Loureiro did not give his Chinese vernacular names in Chinese characters, as this course would have rendered them much more dependable, much more easily located, and infinitely better as clues to what he intended to describe than do his transliterations, giving Portuguese values to the letters used.

It is a well-known fact that the proper transliteration of Chinese sounds

through European values of Arabic letters is distinctly difficult. For these sounds Loureiro used certain diacritical marks, and for certain sound values that he could not indicate by normal letters and diacritical marks, he used mutilated types of the letters b, d, o, and u, as explained on page xv (ed. Willdenow, page xx) of the introduction to the Flora Cochinchinensis. In practice it has been found difficult to pronounce many of the local Chinese names so that they become intelligible to Chinese residents of Canton. Thus Loureiro's Chinese names have been of comparatively little value as clues to the identity of the species to which he ascribed them. It is judged that some of them are "false names" or, what is more unlikely, names that have become obsolete. On the other hand, many of the Anamese names cited by him are still in current use for the same species to which he applied them, and not infrequently supply confirmatory evidence in connection with interpretations herein made.

Since Loureiro lived at Hue, the capital of Cochinchina, for nearly thirty-six years, it may be safely assumed that most of the Indo-China species described by him were based on material secured in the immediate vicinity of that city. In a few cases Hue is definitely cited as the locality and occasionally other places are indicated. As most of Blanco's Philippine species should be interpreted largely from material representing species now growing in those provinces contiguous to Manila so should most of Loureiro's Indo-China species of doubtful status be interpreted largely on the basis of those plants now growing [45] at Hue and in its general neighborhood. Hue, then, is the *locus classicus* for many of Loureiro's species; yet the importance of this locality as a region needing intensive botanical exploration has been curiously overlooked, and many other parts of Indo-China have been much more extensively and intensively explored from a botanical standpoint than has Hue.

One of the reasons why my original manuscript of 1919 was withheld from publication for so long was my full realization that what was most needed in reference to the solution of many problems raised by Loureiro was intensive and extensive botanical collections from Hue and vicinity with notes as to habitats, relative abundance of the various species, economic uses, and local names. It was not until after I left the Orient at the end of 1923 that an opportunity presented itself when, on my recommendation, this region was selected by Chaplain and Mrs. J. C. Clemens, who made extensive collections there from May to July, 1927, and Mr. Roy Squires, who made similar but smaller collections near Hue, January to May, 1927. These two collections of Anamese material have been of the very greatest value to me in connection with my present attempt to determine the status of the numerous enigmatic genera and species of Loureiro. In many cases actual plants from the vicinity of Hue, studied in association with Loureiro's descriptions, led definitely to the interpretation of some hitherto doubtful species. I am confident that had the local names been consistently recorded, the collections already available would have solved the problems of other species that are still of doubtful status. The local name of a plant, used with discretion and understanding, very frequently supplies the clue from which the identity of a hitherto doubtful species can be determined, particularly in such cases as Loureiro provided when he placed his

new species in totally wrong groups or when he misinterpreted various characters or published descriptions that were erroneous in essential details. I am under special obligations to Doctor Aug. Chevalier of Paris, who kindly loaned to me for study a special collection of Anamese plants prepared by de Pirey in 1919, with special reference to local names cited by Loureiro. These in many cases supplied confirmatory evidence which materially assisted in placing some of Loureiro's species.

Fortunately Loureiro was careful to record native names. Even if he did make errors in this field, it is distinctly to his credit that he consistently compiled these data, even as it is regrettable that some modern botanists fail to realize their utility; many ignore even such local names as are recorded on herbarium labels. Even in some standard floras where common names are consistently given, one is frequently impressed by the fact that many of the common names given are coined ones, while many such names in current use are not even recorded.

Modern systematists, in interpreting the obscure species of early authors, in general do not attach sufficient importance to the local names of plants. Unfortunately the rich collections in the great herbaria are particularly poor in reference to both the local names and the economic uses of the plants they contain as herbarium specimens, so that in many cases no blame can be attached to the systematist for the fact that the necessary data are not available to him. It is perhaps more the fault of our herbarium systems than of the individual worker. We pride ourselves on the assumption that the Latin binomial is theoretically fixed, but, as all systematists know, theory and fact are not in agreement. Due to one cause or another, changes in binomials have been exceedingly frequent in modern taxonomic work, particularly in the past forty years.

While many local names are used for a particular species over a very wide culture [46] area, others are over small geographic areas. This has been found to hold for the Amboina species described by Rumphius previous to 1700, published between 1747 and 1755; also for the Philippine species described by Blanco from about 1815 to 1845, and for many of Loureiro's Indo-China and Chinese species. Some local names are used in a generic rather than in a specific sense; others recorded in literature—and perhaps many of these—are names made up to suit the occasion by the individual consulted; and some names that are recorded in literature are doubtless obsolete.

The significance of the name is sometimes important, also knowledge as to whether it is used for a definite species or is loosely applied to a number of perhaps unrelated ones having certain obvious characters in common. Thus, the Philippine names *malakafé* (literally false coffee) and *malabayábas* (literally false guava) are coined names based on fancied resemblances to coffee and to the guava, hence of little value. The name *sampinit* is applied to various unrelated spiny plants such as *Rubus, Caesalpinia* and *Pterolobium,* and even to *Hibiscus surattensis,* representing the Rosaceae, the Leguminosae and the Malvaceae. The Chinese name *ye tau* (literally wild bean) is used in Kwangtung for various leguminous plants, including herbs, vines, shrubs, and trees.

To one unfamiliar with the Anamese language it is, of course, difficult

to evaluate local plant names, for frequently these names have definite and often descriptive meanings. The Anamese names are difficult to use because of their construction and because in alphabetized lists one never knows whether or not a "descriptive" term has been used or not as the first part of a name. Thus in Loureiro's work about 40 of his Anamese names begin with the word *co* (= herb); over 400 begin with *cây* (= tree); about 30 with *hoa* (= flower); over 20 with *nam* (= south); about 60 with *rau* (= vegetable), etc., most of the names consisting of from two to three or four separate words.

Local names should always be used with caution, and specimens bearing these must be critically compared with the original description of the species it is suspected the specimen may represent. Unfortunately, some authors fail to realize that *the name must be used in association with the published description.* Thus A. Chevalier, in proposing various reductions of Loureiro's species (Cat. Pl. Jard. Bot. Saigon 1919), placed too much trust in the local names, not realizing the necessity of taking into consideration the descriptive data given by Loureiro as a check on the correctness of a reduction based on the modern use of a local name. In several cases he transferred Loureiro's specific names to genera totally different from the ones represented by the original descriptions, and in some cases even to families remote from the ones in which they properly belong.

Loureiro, like all others who have recorded local names of plants, sometimes recorded the wrong name for the plant described and in some cases he misapplied economic uses as well as local names. It is always a safe assumption never to accept an identification based on a local name unless the plant bearing the local name conforms reasonably well with the characters indicated in the original description.

The botanist with little or no field experience in regions like Indo-China, Malaysia, and the Philippines is apt to underrate the value of native names as indicating definite species. Many of these are invariably applied to individual species; they have been so used for centuries and will continue to be so used for centuries to come regardless of our nomenclatural vagaries in the use and application of scientific binomials. In very numerous cases in dealing with the botanical work of such authors as Blanco and Loureiro, the native [47] names recorded by them are of the very greatest significance, supplying most important clues to the identity of this or that species perhaps erroneously placed as to their genera or inadequately or even erroneously described. Very numerous cases could be cited in Loureiro's work where the local name alone has proved the open sesame to the identity of this or that species, sometimes when all other methods of botanical detective work have failed; and in numerous other cases have supplied dependable corroborative evidence to support specific interpretations. Thus may be cited such cases as the following where, but for the native name, it is highly probable that a considerable number of the species could not definitely be placed. . . .

These are but a few of the numerous cases where the significance of the local name has been discussed in this work under individual species, as supplying the clue to the identity of this or that one, or as corroborative evidence supporting the accepted reductions. The local names used in Lou-

reiro's time in Indo-China are in perhaps the majority of cases there still applied to the same species for which he recorded them. Their significance cannot safely be ignored. Field work prosecuted in Anam, particularly in the vicinity of Hue, with special reference to the local names, will unquestionably yield material and data that will in turn elucidate additional Loureiroan species which I have not been able definitely to place in this work on the basis of material and information available to me.

Concluding Remarks

In interpreting species based on pre-Linnaean descriptions and illustrations, such as those of Rheede and Rumphius, as well as those described by such post-Linnaean authors as Blanco and Loureiro, the modern systematist is not always consistent. Sometimes individual species have been interpreted from botanical material originating in regions remote from those that supplied the original specimens; not infrequently, amplified descriptions of later authors based on erroneously identified specimens represent species very different from [48] the one intended by the original author. In interpreting a Chinese, an Indo-Chinese, a Mozambique, or an East African species described by Loureiro, it becomes essential to take into consideration the present day vegetation of these regions and to attempt an interpretation of Loureiro's species on the basis of those now growing in or near the original localities. It is distinctly not safe to identify a Loureiroian Chinese or Indo-Chinese species with material representing a species known only from Java or India or some other region remote from the type locality.

In this introduction I have attempted to outline some of the difficulties the modern taxonomist encounters when he attempts to interpret descriptions based on material no longer extant, and particularly when a certain percentage of the descriptions are manifestly not technically correct. In the detailed discussions of individual species in the following presentation, I have given further data, where it has been considered necessary, to explain the acceptance of this or that name, and to justify my present interpretation of the individual species concerned. It is not to be expected that my interpretations are always correct; it is hoped that in the majority of cases they are reasonably so.

No attempt has been made to give the full synonymy, with all the more important literature references where later authors have considered Loureiro's species. In general such synonyms as are necessary to explain the accepted name are given, and a serious attempt has been made to detect and to record all synonyms actually based on Loureiro's original descriptions. In spite of an extensive examination of the widely scattered literature bearing on this subject, it is not to be expected that all of these have been detected; those actually recorded exceed 750.

The taxonomist who critically compares the individual references with those in standard and other works will note a number of discrepancies between accepted authorities for certain binomials and their places of publication as between this work and standard literature. Botanical literature is replete with erroneous and incomplete references, but in this work, wherever it has been possible to do so, the original sources have been consulted, and

the references as given have been carefully checked as to authority, volume, page, and date of issue. In somewhat over 6,700 references given in this work very few have not thus actually been verified, these representing the few cases where the original works have not been accessible to me.

The original manuscript on which this work was based was completed in Manila in 1919, as noted on page 246 [4]. Beginning in August, 1931, the manuscript was entirely rewritten, greatly amplified, and each species was critically reconsidered. The total number of species described by Loureiro has been reduced to 1157 by reduction to synonymy, where Loureiro manifestly described the same species a second, third, or even a fourth time, and under different names. While four new generic names proposed by later authors but based on certain species described by Loureiro, and twenty-three of Loureiro's species remain unplaced as to their proper families, most of his other genera and species have been placed with reasonable accuracy and the synonymy adjusted in accordance with my present understanding of each case. As a better understanding of the individual species considered is gained, some further changes in nomenclature are to be expected, and there naturally will be some changes made as the concept of generic limits changes. Of the Loureiro species that have been placed as far as their proper families are concerned, about 140, including cellular cryptogams, I consider to be indeterminable as to the species; of these about 80 [49] can be safely referred to the genera they actually represent. This is a distinctly better showing than I had hoped it possible to make when work on this project was initiated. Doubtless from time to time in the future some of these unplaced species can be located as additional data and material become available, but the above number represents the residue that I cannot dispose of on the basis of the unsatisfactory original descriptions alone and such other data as are now available to me.

For convenience Loureiro's original arrangement by the Linnaean classes and orders has been broken down, and the genera and species, as far as it has been possible to place them in accordance with modern ideas, have been arranged in approximately the sequence of families and genera in Engler and Prantl's "Die natürlichen Pflanzenfamilien." . . .

—XI—

SCUTTLING ATLANTIS AND MU*

[142] Speculation on the possible relationship between the pre-Columbian civilizations of America and those of Eurasia continues to fascinate a great number of people and to produce a continuous volume of literature. The subject affords a permanent source of copy for popular writers, who consistently overstress the similarities and assumed similarities between early civilizations of the two hemispheres. "Aztec link to Chinese seen," "Peruvian mummies point to lost continent," and similar head-lines too often betray the fact that some enterprising explorer of Mexico, Yucatan, Central America, Bolivia, or Peru, or his press agent, is preparing to lure the public into providing further funds for the support of future raids into the wilds of nature and fiction. Perhaps it was natural for the earlier European observers in America to attempt to explain what they found here on the basis of possible ancient contacts with Eurasia. But this is no reason why we should give much credence to the idea that the pioneers of civilization in America were the lost tribes of Israel, the Egyptians, the Phoenicians, the Mesopotamians, the Greeks, the Latins, the Welsh, or the inhabitants of an imaginary Atlantis or Mu, or that the advanced peoples of eastern Asia were at all involved.

The ardent exponents of Atlantis, and the fewer but equally ardent exponents of Mu, postulate ancient continents or island groups, long since sunk beneath the sea, the one in what is now the Atlantic basin, the other in the Pacific, readily explaining all resemblances and pseudo-resemblances between the civilization of the New World and that of the Old, whether in architecture, sculpture, hieroglyphics, or in civil, ecclesiastical or political organizations on the assumption of ancient contacts across these lost lands. They attribute, with no tangible evidence, a high order of civilization to the hypothetical peoples of these equally hypothetical areas. The extremists visualize the Atlanteans as [143] the parent-colonizers of both the Mediterranean and Caribbean shores, but overlook the fact that there are no philological relationships between American and Mediterranean languages.

As to the Atlantis fable, the fountain-head and oft-quoted classic authority is Plato's *Timæus,* which purports to be a conversation between certain Egyptian priests and Solon regarding the continent. We know that similar legends occurred in various forms among various ancient peoples and it may be assumed that the Atlantis idea was one of these and sprang out of some folk-tale current among several races centuries before Plato dignified it with his name. The Atlantis cult is singularly active, particularly in Europe. If we may trust newspaper accounts, Chevalier's recent paper on the vegetation of the Cape Verde Islands, a group the Atlantis enthusiasts claim to have been part of the ancient continent, provoked the wrath of the Parisian disciples of the Atlantis theory. According to the dispatches "Many scientists are convinced that there is a definite foundation for the legend of the lost Atlantis." But before the close of the 15th century domesticated plants and animals common to the two

* E. D. Merrill, "Scuttling Atlantis and Mu" (The American Scholar 5:142-148, 1936).

hemispheres were conspicuous by their absence; yet colonies of ancient Atlantis in the Mediterranean basin and in Mexico and Central America might be expected to have at least some cultivated plants and domesticated animals in common, unless it were indeed true, as one enthusiast affirmed, that the remarkable people of Atlantis had developed no agriculture whatever.

There is a certain school of ethnologists, known as diffusionists, who claim that all advances in civilization originated in and radiated from a common center. They too would derive ancient American civilizations from Eurasia through prehistoric contacts across the Pacific and the Atlantic, undaunted by the distances between the two hemispheres, by manifest lack of recorded contacts until after 1492, and by the absence or inadequacy of ocean-going boats in ancient times. This school apparently cannot admit that any great invention, innovation, or advance in civilization could conceivably have been made independently at different times and among different peoples. In [144] taking exception to certain of my conclusions based on agriculture and on the dissemination of cultivated plants, one of its disciples argued with me a few years ago in this wise: Did not agriculture originate in Egypt? Did not the seeds of the wild barley float down the tributaries of the Nile from Ethiopia? Were not these barley seeds self-sown along the mud banks of the Nile? Did not primitive man here find an annual self-sown crop of edible seeds for the taking? On the basis of this natural agriculture were not other advances made, ultimately permitting the development of a highly specialized civilization in Egypt? And from this center did not civilization spread over the world, even to distant America? One need not be a botanist to refute the argument, for every farmer's boy knows that barley seeds do not float and that in water they soon swell and lose their viability as do all cereals. Could such a grain float several hundred miles and still remain viable? No, the "floating barley" would have to be developed by primitive man, for it does not exist in nature. Furthermore wild barley is supposed by botanists to be a native of central Asia. What would the ecologists say regarding a natural habitat of barley that would permit of many of its seeds even falling into running water? What would they reply to the claim that any annual grass could each year become established along the mud banks of the Nile in such quantities as to form an attractive self-sown crop yielding edible seeds as the water receded, and winning out in competition with the luxuriant perennial marsh, aquatic, and riparian native vegetation? Such a theory of the origin of agriculture is manifestly untenable; and with its fall also falls the idea that Egypt was the central source of primitive agriculture. Moreover not a single one of the food plants cultivated by the ancient Egyptians was native to the Nile Valley; they must have come from neighboring countries where agriculture long antedated even the most primitive cultivation in the valley of the Nile.

What is the bearing of the origin and dissemination of cultivated plants and domesticated animals on the problem of the origin of civilizations? Agriculture is undoubtedly essential to [145] civilization, for without assurance of an ample and dependable food supply civilization could not have been developed and could not persist. Of the several hundred thousand different species of plants now known, only a few hundred are

cultivated for food, and of these a much smaller number may be considered basic food plants. The number of domesticated animals is also very small. And all of these plants and animals were in domestication somewhere in the world long before the dawn of recorded history, whether in Eurasia or in America; but not a single basic cultivated plant and only one domesticated animal, the dog, was common to the two hemispheres in pre-Columbian times. This significant fact is usually overlooked although as early as 1883 de Candolle, in his classic *Origin of Cultivated Plants,* clearly stated that after extensive investigations of the subject he had noted no indication of contacts between the people of the Old and the New Worlds before Columbus' voyage in 1492. The fact was so manifest that he did not consider it necessary to amplify his statement further. It was the expansion of European activities that led to the introduction of Eurasian cultivated plants into America and vice versa.

What answer can the enthusiatic Atlantis disciples make to this simple question—What could have been the agriculture of ancient Atlantis that transmitted to the supposed descendant colonies in Europe and America no single cultivated food plant or domesticated animal in common? In prehistoric times expanding and colonizing peoples took with them the plants and animals indispensable for their well-being, as witnessed by the dissemination of Indian species with their Sanscritic names throughout Malaysia, and by the migrating Polynesians who took their few but to them important food plants out of Malaysia. For the coconut, the most important of the cultivated palms, we find the names *niu, niuh, niog, ni, nia, nioe, noe,* and *nor,* all cognate forms of one word, in actual use all the way from Madagascar across the Indian Ocean, through Malaysia, to the extreme eastern islands in Polynesia, Hawaii, and the Marquesas; but the coconut did not reach America until it was introduced [146] into Brazil by the Portuguese and a little later into Mexico by the Spaniards. The cognate forms of one word merely indicate that the name was transmitted with the plant in prehistoric times, quite as in modern times such names as tea and coffee have been transmitted through commerce all over the world, the former from the Chinese *tay* and *cha* and the latter from the Arabic *gahwe.*

In modern times our ancestors brought with them from Europe the cultivated plants and domesticated animals which had become necessities of living in the home land—the wherewithal to establish a permanent agriculture and a permanent civilization in America. To these they added certain outstandingly important species which they found cultivated by the aboriginal Americans. Had there been earlier communication between Eurasia and America certainly the advanced people of the Old World would have brought with them at least some of the cultivated plants and domesticated animals characteristic of the civilization of Eurasia. It is inconceivable that advanced peoples reaching America without food plants could have developed an agriculture here on the basis of native, wild-growing plants. The development of agriculture in aboriginal America was a slow process extending over some thousands of years, initiated by primitive invaders who apparently came over a northern route. That they brought with them nothing but the common dog is incontrovertible evidence that they were nomads, living by hunting and fishing, for in the

inhospitable regions of the northern parts of the continent the practice of agriculture was impossible. In the many generations involved in their southward migration they would have lost all knowledge of the art of agriculture. This they acquired *de novo* as they learned the qualities of the various native plants they later brought into cultivation. The developments of agriculture in America parallel that in the Old World but was based on an entirely different series of plants and animals.

Native American species are totally different from those of the Old World, and for the most part belong in genera that have [147] no representatives in Eurasia. One notes also another striking difference. All of the cereals, with one exception, and most of the temperate-zone vegetables and fruits are of Eurasian origin, originally from temperate or subtemperate regions, whereas most of the American species are of tropical or sub-tropical origin. In each hemisphere there were certain limited areas wherein most of the basic cultivated food plants occurred originally as wild species, and in these limited areas or in regions contiguous to them originated the ancient civilizations. In America the outstanding centers were the highlands of Mexico, Peru, and Bolivia, with secondary centers in Central America and Yucatan. In Eurasia the important areas were the Mediterranean basin, Asia Minor, limited parts of central Asia, and certain parts of northern India and of China.

American contributions to our modern food supply include maize or Indian corn, the potato, sweet potato, tapioca or cassava, the lima bean, field and garden beans, the scarlet runner bean, squash, pumpkin, tomato, pepper, Jerusalem artichoke, sunflower, peanut, arrow-root, chayote, papaya, cacao, avocado, pineapple, custard-apple, cherimoya, soursop, sapote, sapodilla, cashew and others. Tobacco is of American origin. In the field of domesticated animals American contributions were few and relatively unimportant: the llama, alpaca, and Muscovy duck in South America and the turkey in Mexico. None of these plants and animals was known in Europe or in Asia until after the close of the 15th century.

Eurasian contributions were much more extensive, including all cultivated cereals (except maize)—wheat, barley, rye, oats, millet, Italian millet, sorghum, teff, ragi, coix, and buckwheat, the latter of course not strictly a cereal; most of our temperate zone vegetables such as the turnip, rutabaga, cabbage, mustard, chard, radish, beet, parsnip, carrot, onion, leek, garlic, shallot, spinach, lettuce, endive, salsify, celery, asparagus, pea, lentil, broad bean, hyacinth bean, chick-pea, cow-pea, and soy bean; also most of our temperate zone fruits such as the apple, peach, apricot, pear, plum, cherry, wine-grape, prune, fig, almond, [148] persimmon, quince, pomegranate, melon, watermelon, and cucumber. The warmer regions of the Old World yielded the banana, orange, lemon, lime, pomelo, date, mango, bread-fruit, jak-fruit, litchi, longan, lansone, mangosteen, coconut, and many other fruits, as well as sugar-cane and various other cultivated economic plants. Furthermore, from Eurasia came most of our domesticated animals, including the horse, cow, sheep, goat, hog, goose, duck, chicken, and pigeon.

The important thing to keep in mind is that not a single cultivated food plant and not a single domesticated animal, except the dog, occurred in both hemispheres until after 1492. The botanical and agricultural

evidence is absolutely and wholly in support of the idea, now maintained by most anthropologists, that man entered America from Asia as a primitive nomad. Here he gradually developed his agriculture on the basis of endemic plants and animals, and on the basis of this agriculture in turn developed the really high civilizations characteristic of pre-Columbian Mexico, Yucatan, Central America, Peru, and Bolivia. Here, as in Eurasia, plants once domesticated, with at least rudimentary ideas of agriculture, were transmitted from advanced to more primitive peoples, some species such as tobacco, sweet potato, maize, bean, pumpkin, and squash being very widely planted in both North and South America, far from their original homes, long before the arrival of the Europeans.

There is no need to seek further for the sources of early American civilizations in Europe or in Asia. In America as in the Old World the growth was from the soil, diffusionists to the contrary notwithstanding. The biological evidence wholly supports the belief that agriculture as an art was developed by primitive man in America independent of and unrelated to that of the Old World. And this point of view gives us at least one securely founded reason for assuming that the pre-Columbian civilizations, in North, Central, and South America, had their origins in a primitive people who achieved their high order of culture uninfluenced by intercourse with either Europe or Asia and without the intermediation of any hypothetical "lost" continent.

— XII —

PALISOT DE BEAUVOIS AS AN OVERLOOKED AMERICAN BOTANIST*

[899] ... Several years ago I acquired two broken sets of Palisot de Beauvois' *Flore d'Oware et Benin en Afrique*,[1] and when [900] these were collated it was found that the two volumes lacked only a few pages of text and a few plates. These broken sets fortunately included 6 of the very rare original fascicle covers bearing the dates of issue of the several parts. Complete sets of this publication are so rare that in 1928 Quaritch listed a copy of the edition with colored plates priced at £180. In describing it he wrote: "This is the only complete copy I have had and the only one that has appeared at auction for at least twenty-five years." Two editions were issued, one with colored, the other with black and white plates. Pritzel gives the title-page dates, Vol. 1, 1804, and Vol. 2, 1807, stating "Rarum idque pulcherrimum opus prodiit 20 fasciculis usque ad annum 1818 vel 1821." Each fascicle consists of six plates and a certain amount of text. It has long been known that the title-page dates were incorrect for the complete volumes, and that the dates on some of the fascicle covers were probably wrong. Data appertaining to the dates of issue of the several parts, prepared by Dr. J. H. Barnhart, are appended to this paper. [not reprinted].

What intrigued me, however, was neither the rarity of the publication, nor its general content, but a statement by A. Jussieu, on page viii of Volume one, in which he refers to Palisot de Beauvois' residence in Philadelphia. Except as the author of various well known genera and species of Gramineae, the name Palisot de Beauvois seldom appears in American botanical literature. Certain species, however, *e.g.*, *Anemone minima* DC. Syst., **1**: 206, 1818, were described from specimens collected by him in the eastern United States. Consulting Harshberger's volume on Philadelphia botanists,[2] I could find no reference to Palisot de Beauvois. It then occurred to me that an inquiry into the matter might determine the cause of Harshberger's omission and, more significantly, the reason why Palisot de Beauvois has remained practically unknown as an early collector of American plants.

[901] A number of sketches of Palisot de Beauvois' life and work have been published,[3] from which it is possible to obtain much informa-

* E. D. Merrill, "Palisot de Beauvois as an Overlooked American Botanist" (Proceedings of the American Philosophical Society 76:899-909, 1936).

[1] **Palisot de Beauvois, A. M. F. J.** Flore d'Oware et Benin en Afrique, **1**: i-xxii, 1-100, *t. 1-60,* 1805-10?; **2**: 1-95, *t. 61-120,* 1810?-21.

[2] **Harshberger, J. W.** The Botanists of Philadelphia and their Work, i-xii, 1-457, *illus.*, 1899.

[3] **Jussieu, A. L. de.** Extrait de la Décade philosophique, No. 10, IIe trimestre an XII. [Flore d'Oware et de Benin] in Palisot de Beauvois, Flore d'Oware et Benin en Afrique, **1**: viii-xi, 1805. Reprinted from Décade philosophique, 10 nivôse, An xii, 1-8, 1804.

Poiret, J. L. M. Palisot (sic!) de Beauvois. Lamarck Encycl., **8**: 744-746, 1808.

Thiébaut de Berneaud, A. Éloge historique de A. M. F. J. Palisot de Beauvois, membre de l'institut de France. Discours que a remporté le prix de la Société pour l'encouragement des sciences, des lettres et des arts d'Arras in 1821, pp. 1-81, *portr.*, 1821. This was originally published in Mém. Soc. Roy. Arras, **4**: 49-116, 1821, but

tion regarding his rather remarkable career. Fortunately, data from the archives of the American Philosophical Society throw some light on his botanical activities in this country. The obscurity of his name in the botanical literature of the West Indies and of the United States is due to the tragic loss of his Haitian and most of his United States collections.

A. M. F. J. Palisot, Baron de Beauvois, was born at Arras, France, July 27, 1752 (not October 28, 1755, as stated by some authors). He was educated at Harcourt College in Paris, and was admitted to the bar in 1772. After the death of his father and the subsequent death of his older brother, he inherited the patriarchal estates and also the positon of receiver of the domains and forests of northern France. In [902] 1777 this positon was abolished. While occupying this position he apparently devoted considerable time to botany studying diligently under Lestiboudois at Lille, and carrying on both field work and laboratory investigations on the structure and sexual relationships of the cryptogams. Undoubtedly his researches were of value, for as early as 1781, Beauvois, then being resident in Paris, became a correspondent of the Academy of Sciences.

Eager to travel and carry on botanical exploration, he had hoped to take part in the explorations planned by Forskål, with the idea of crossing Africa from the Red Sea to Senegal or Guinea, but this plan, apparently from lack of support, was never consummated. In 1786, however, he associated himself with Captain Landolphe on a journey to the Gulf of Guinea. The object of the expedition was to establish a trading settlement in Owara. He sailed from Rochefort on the "Perou" July 17, 1786. It was apparently his hope that once in Africa he might find a way to consummate his earlier plans of crossing the continent. There seems to have been no intention on his part of entering the service of the company organized to develop the trading station, as he provided his own equipment and supplies. He had expected to be absent about four years, but twelve years actually elapsed before he returned to France.

At whatever ports the ship stopped on route, such as Chamah and Koto on the Gold Coast, he collected natural history material. He reached

without the portrait. The reprint differs further in having the bibliographic references in scattered footnotes, while in the original they are assembled at the end of the paper, pp. 113-116.

Depping, G. B. Palisot de Beauvois (Ambroise-Marie-François-Joseph). Biogr. Univ., **32**: 412-417, 1822.

Cuvier, G. L. C. F. D. Éloge historique de M. de Beauvois. Mém. Acad. Sci. France, **4**: CCCXVIII-CCCLXVI, 1824. Translated into English and published as "Biographical memoir of Baron de Beauvois." Edinb. New Philos. Journ. **1829**: 1-21. 1829.

Quérard, J. M. Palisot de Beauvois. La France Lit. Dict. Bibl., **6**: 563-564, 1834.

Félétz, C. M. D. de. Palisot de Beauvois (Ambroise-Marie-François-Joseph). Biog. Univ., ed. 2, **32**: 14-19, n. d. (about 1857).

Hoefer, J. C. F. Palisot de Beauvois (Ambroise-Marie-François-Joseph, baron de). Nouv. Biog. Gén., **39**: 86-88, 1865.

Urban, J. Palisot, Ambroise-Marie-François-Joseph P., baron de Beauvois. Symb. Antill., **3**: 96-98, 1902.

Chase, A. Biographical sketch [of Palisot de Beauvois]. Contr. U. S. Nat. Herb., **24**: 210-224, 1925.

Depping also cites an "éloge" of Palisot de Beauvois in the Rap. Trav. Soc. Agr. for 1819, published in 1820, a publication I have been unable to trace.

his destination November 17, 1786. During the years 1786-87 he diligently explored Owara and Benin, sending his collections, as often as possible, to Jussieu in Paris. From a health standpoint the expedition suffered grievously, two hundred and fifty of the original three hundred men succumbing to fever within the first five months, among them Beauvois' brother-in-law and his two European servants. In spite of his own ill health he explored Owara, Benin, and a part of Old Calabar, sending some shipments of plants and insects to Jussieu in Paris. After fifteen months in Africa recurrent attacks of fever so weakened him [903] that his friend, Captain Landolphe, placed him on a slave ship bound for Haiti.

The vessel remained for a month at Prince's Island, where Beauvois contracted an even more serious illness. The trip to Haiti took three and one-half months, during which time many of the slaves died, as well as two European passengers. Beauvois recovered very slowly and was barely convalescent when the ship reached its destination in July 1788. Here he was received at the home of his uncle, Baron de la Valletière, commandant of the Môle St. Nicholas, and soon recovered from his illness.

Within a few months after his arrival at Haiti he commenced an intensive botanical exploration of the country. His field work, dangerous because of the revolt of the slaves against their white masters, which rendered exploration uncertain, was prosecuted under peculiar difficulties. Conditions becoming more and more critical, he was finally obliged to discontinue his botanical work in order to take part in the discussions of the colonial council, and to command various detachments of troops sent against the rebellious slaves. Between 1788 and 1791, however, he managed to assemble a large herbarium and sent many shipments of seeds to France.

Political conditions becoming progressively worse in Haiti, Beauvois was sent to Philadelphia as a commissioner of the colonial government to solicit food supplies, funds, and, if possible, the intervention of the United States in the affairs of the French Colony, leaving Haiti on October 16, 1791. On January 20, 1792, while residing in Philadelphia, he was elected a member of the American Philosophical Society, the entry reading thus: "Palisot de Beauvois, de la Soc. d. Sc. et Arts du Cap François et Corr. de l'Acad. d. S. de Paris." During the time he was in the United States he collected botanical material as he had the opportunity to do so, from Philadelphia southward.

The records of the American Philosophical Society[4] show [904] that he attended its regular meetings on February 3, 1792, April 18 and August 15, 1794, March 18, 1796, and January 27, February 10, February 17, March 3, and April 7, 1797. These dates indicate four different periods of residence in Philadelphia. That he retained his interest in the Society long after his return to France, is evidenced by an entry, under date of April 15, 1816, that a donation, the amount not indicated, had been received from P. Beauvois.

He returned to Haiti June 24, 1793, just after the burning of Cap Français, to find his house ruined and the natural history collections assembled over a period of three years utterly destroyed, including also

[4] Early Proceedings of the American Philosophical Society, 1744 to 1838, i-iii. 1-875, 1884.

his African sketches. He was imprisoned for a time but was fortunate enough, through the intervention of a mulattress whom his uncle had freed from slavery, to escape execution, and to be sentenced instead to deportation to the United States. In the meantime his African collections, which had been left in storage in Owara under charge of Captain Landolphe, were destroyed when the settlement in Africa was plundered by the British in 1791.

Palisot de Beauvois left Haiti a second time on an American ship, which was intercepted by the British who seized all his belongings except one small trunk. He thus landed in Philadelphia a second time utterly penniless. To add to his misfortune his name had been placed on the list of *émigrés* and his estates had been sequestered by the French revolutionary Government. The protests of his friends and family succeeded only in preventing the sale of his possessions. There was no way for him to procure funds from France, and to return, as a proscribed *émigré,* to the reign of terror would have meant death. On his arrival he was received as a guest by Dr. Caspar Wistar, the noted Philadelphian physician. Later he assisted in Peale's museum. It was apparently during this period that he wrote the descriptive catalogue of Peale's collection.[5] At times he supported himself by teaching French and music, and playing in a circus orchestra.

[905] Here in spite of the handicap of very meager funds he proceeded to prepare a new herbarium, making also collections of insects, birds, fishes, reptiles, shells, animals, and even fossils. He continued to send to the Paris Museum packets of seeds, some of which reached their destination, others being intercepted in transit. Later the new French minister to the United States, M. Adet, favored him with his support, enabling him to travel for a period of three years in various parts of the country and to assemble more extensive collections of natural history material. His explorations extended from New York to Ohio southward to Georgia, including the southern Appalachians, with a trip into the regions inhabited by the Creeks and the Cherokees, he being authorized to make a study of the fur trade and agriculture of the southern states, to compile statistical data, and to make natural history collections. These collections were lost when the ship on which they were being transmitted to France was wrecked in the vicinity of Halifax. M. Adet, however, had forwarded seeds collected on Beauvois' explorations and on his return to France took with him various living animals that Beauvois had secured for the Paris Museum. Some of his botanical material must have reached France, as certain Palisot de Beauvois United States specimens are still extant.

In the archives of the American Philosophical Society a few letters from Palisot de Beauvois are preserved. One, addressed to Dr. Caspar Wistar, was written at Charleston, South Carolina, May 20, 1796, from which we learn that Beauvois had just arrived from Savannah, where he had found no new animals or minerals, but had collected a great many undescribed plants, although no new genera were represented. He notes

[5] **Palisot de Beauvois, A. M. F. J.** Catalogue raisonné du Muséum de Mr. C. W. Peale. Philadelphia, i-xiv, 1-42, no date. Translated into English and republished by **Peale, C. W.** and **Beauvois, A. M. F. J.** A scientific and descriptive catalogue of Peale's Museum. Philadelphia, i-xii, 1-44, 1796.

that he there met Michaux, who had just returned from an eleven months' stay in the Cherokee country, and had made a great collection of plants in that region. In a letter written in Richmond, Virginia, April 25, 1798, addressed to Thomas Jefferson, he discussed chiefly the animals and fossils that he had observed, explaining that he was incorporating the data in the form of a letter because of his [906] uncertainty as to whether or not Jefferson would be in Philadelphia when he returned in order to take passage to France. He spoke of the extreme richness of vegetation of the regions that he had visited.

Eventually his friends in France succeeded in having Beauvois' name removed from the list of *émigrés* and he was permitted to return. He accordingly abandoned his plans for further travel in the Arkansas region beyond the Mississippi River and returned to France, landing at Bordeaux in August, 1798, after an absence of twelve years. From the time of his return until his death, January 21, 1820, he busied himself with the study of grasses, various groups of cryptogams, and with that part of his African collection of plants and animals that he had sent to Jussieu before leaving Owara for Haiti. He prepared and published many short papers and several larger ones, notably his work on the grasses and the folio works on the plants and insects of Owara, leaving, however, a number of unfinished and hence unpublished manuscripts. A bibliography of his publications is appended to this paper [not reprinted].

That Palisot de Beauvois was deeply interested in natural science is manifest. Few individuals in a similar position, subjected to the vicissitudes that he endured, would have had the courage and persistence to continue their investigations. Only the field naturalist who is interested in studying his own collection from regions previously unexplored, or at most only inadequately known, can fully appreciate the tragedy of losing one's collections through no fault of his own, and Palisot de Beauvois lost three great collections of plants and other natural history material made between the years 1786 and 1798—the Owara and Benin collections destroyed in Africa in 1791; the Haitian collection, burned at Cap Français, Haiti, in 1793; and the greater part of the United States collections, lost at sea near Halifax in 1798. But for these repeated misfortunes, his name undoubtedly would have been a very important one in the early studies of the floras of Haiti and of the eastern United States. As it is, the name Palisot de [907] Beauvois rarely appears in the special botanical literature pertaining to North America. He lived in Philadelphia for many months, at four different times between 1791 and 1798, and yet a modern Philadelphian writing extensively on the botanists of that city, was apparently unaware of this contributor to the history of the science in Philadelphia in spite of the fact that Beauvois' first botanical papers were written in Philadelphia and published in the *Transactions* of this society. Palisot de Beauvois died in Paris, January 21, 1820, at the age of sixty-eight.

Some of Palisot de Beauvois' botanical collections are still extant, being largely preserved in the herbarium of the Jardin botanique at Geneva, Switzerland.[6] Professor M. L. Fernald, Curator of the Gray Herbarium,

[6] **Hochreutiner, B. P. G.** Reliquiae Palisotianae ou collections et notes manuscrites inédites rapportées d'Oware et de Benin par Palisot de Beauvois. Ann. Conserv. Jard. Bot. Genève **2**: 79-101, 1898.

informs me that there are scattered specimens in that great reference collection, received many years ago from Paris, the collector being indicated merely by the initials "P. B." There are some sheets in the herbarium of the Philadelphia Academy of Natural Sciences, marked "Beauv." Those that I have examined, my attention having been called to them by Dr. F. W. Pennell, were all from British India, a region Beauvois never visited. They doubtless represent collections made by other individuals, transmitted by Beauvois in all probability to the American Philosophical Society.

Palisot de Beauvois' interests were wider than the field of natural history. Quérard states that he was the author of several plays, among them one entitled "Du Railleur" which was not unworthy of presentation, a comedy in verse, in five acts. I have personally seen no works of this type by Palisot de Beauvois nor have I located other bibliographic references to them. It is, of course, possible that the contemporary dramatist Palisot de Montenoy (1730-1814) may have been confused with Palisot de Beauvois, although the title "Du Railleur" does not appear in any bibliography of Palisot de Montenoy that I have seen. Of more interest perhaps, [908] from a purely literary standpoint, is the probability, or at least the possibility, that Palisot de Beauvois was the author of the anonymous "Odérahi,"[7] a work that had considerable vogue in the early part of the last century. By some its authorship has been accredited to Chateaubriand.

"Odérahi" is discussed in considerable detail by Chinard,[8] who however at that time did not know of the earlier edition of 1796, having examined a copy of the 1801 edition in the Newberry Library, Chicago. He informs me that there is also a copy in the New York Public Library and one at the University of Michigan. This was followed up by Giraud,[9] who located a copy of the second edition of Veillées américaines, 1796, in Paris. He states that there are 17 "parts" in the three volumes, the first 6 including "Eliza," the 7th "Eugenie" and the last 10 "Odérahi," the latter republished in 1801. He notes further that the introductory and explanatory statement "Le cultivateur à ces Veillées" is signed "P. B." Dr. Chinard has recently located a copy of this work in the John Carter Brown Library. The first edition of this work seems to be unknown. Hazard[10] later considered the case and concluded that Palisot de Beauvois rather than

[7] **Odérahi,** histoire américaine; contenant une peinture fidelle des moers des habitans et d'intérieur de l'Amérique septentrionale. Odérahi est la soeur ainée d'Atala. Paris. 1801. First printed as one of the stories in "Veillées américaines" ed. 2, 1796. Spanish translation: "Oderay. Usos, trages, ritos, costumbres y leyes de los habitantes de la América septentrional, traducidas del Francés é ilustradas con varias notas críticas por Don Gaspar Zavala y Zamora," pp. 1-288, 1804. German translation: "Oderahi, eine amerikanische Erzählung. Seitenstück zur Atala. Von demselben Verfasser. Aus dem Französischen übersetzt," i-x, 1-412, 1803. The second edition of the "Veillées américaines" consists of three 12 mo. volumes **1**: 1-192; **2**: 1-202; **3**: 1-196, 1796. The text of "Odéraï" commences on page 69 of volume two, with the heading "Septième Veillée. Odéraï."

[8] **Chinard, G.** Une soeur ainée d'Atala. Odérahi, histoire américaine. Rev. Bleue, **1912** (2): 779-785, 1912.

[9] **Giraud, V.** Les Veillées américaines. Contribution à l'histoire des sources d'Atala. Rev. Bleue, **1913** (1): 154, 1913.

[10] **Hazard, P.** L'auteur d' "Odérahi" histoire américaine. Rev. Lit. Comp., **3**: 407-418, 1923.

Chateaubriand was the author of "Odérahi." To the title of the edition of 1801 is added the phrase "Odérahi est la soeur aînée d'Atala"; Chateaubriand was the author of Atala.

[909] Quérard's statement regarding Palisot de Beauvois' authorship of certain plays was based on Thiébaut de Berneaud's "Éloge historique." Palisot de Beauvois was a rather voluminous writer on natural history, at times somewhat of a pamphleteer, apparently the author of several plays, and thus may well have been the author of the romances forming the "Veillées américaines." If he really be the author of the latter, then it is rather strange that Thiébaut de Berneaud did not know of it, because he must have been rather intimately acquainted with Palisot de Beauvois, and he had access to the latter's published and unpublished writings. One wonders why the author of a romance that attracted sufficient attention on the occasion of its second printing soon to be translated into both Spanish and German, should elect to remain anonymous. . . .

— XIII —

ON THE TECHNIQUE OF INSERTING PUBLISHED DATA IN THE HERBARIUM*

[173] Beginning with volume eighteen, number one, January, 1937, a small special edition of the Journal of the Arnold Arboretum has been prepared printed on one side of the paper only. The objective is to provide a form, without sacrificing two complete copies of each issue, for the preparation of "herbarium clippings" whereby pertinent taxonomic data may become available for insertion into herbaria in association with the actual specimens representing the species described or discussed. This special edition is available only on an exchange basis for similar material that may be used for preparing herbarium clippings for use at the Arnold Arboretum.

Those familiar with the older herbaria realize that individual botanists in the past have occasionally attached copies of their original descriptions to the herbarium sheets, but nowhere does one find any considerable number of these. In my own experience in the Philippines previous to 1923 I occasionally had typed and inserted into the herbarium copies of original descriptions, but like most busy botanists elsewhere I never found time to clip and insert copies of my own published descriptions. It was only after my transfer to the University of California in 1923 that it occurred to me that a more comprehensive plan of inserting actual descriptions into the herbarium would be advantageous. Thus over a period of nearly six years many thousands of such items were incorporated in the herbarium, the great advantage being that even where authentically named specimens were not available, the actual description was in place. Special attention was given to published data on the floras of China, the Philippines, and Malaysia. This trial, involving perhaps 40,000 entries, convinced me of the great utility and the eminent practicability of the scheme, although while engaged on this task I was seriously assured by some of my colleagues that the project was an impracticable one.

On my transfer to the New York Botanical Garden in 1930, I there initiated the same system on a small scale in the early part of the year, but I always had the feeling that some of my associates there considered the matter of slight value and perhaps some of them even thought that [174] I was to a slight degree mentally unbalanced in initiating what was a most radical innovation. In November, 1930, when unexpectedly it became possible to secure the services of numerous individuals through the privately supported Emergency Work Bureau, it became immediately necessary to plan productive projects whereby the talents of this supplementary force could be utilized to advantage. Starting with six temporary employees, the number was rapidly increased until within two months about 100 extra employees were at work. The further development of the preparation of published data for herbarium inserts was made an important project. A certain number of assistants, under supervision, were assigned to the task of preparing the clippings, utilizing two printed copies of the volume or

* E. D. Merrill, "On the Technique of Inserting Published Data in the Herbarium" (Journal of the Arnold Arboretum 18:173-182, 1937).

article that it was desirable to clip. Others were assigned to the task of typing original descriptions and critical notes from the older periodical literature. Because of lack of interest on the part of certain staff members, not accustomed to the advantages of the system, the geographic areas first stressed were the same as those selected at the University of California. Later this was extended to cover all fields in which the New York Botanical Garden was actively interested, North, Central, and South America, the West Indies, Asia, Malaysia, and Polynesia.

No record of the number of items incorporated in the herbarium was kept. A very conservative estimate is that the number is now over 700,000 and it may well be greatly in excess of that number. Some idea of the extent of the operations may be gained by the statement that among the periodicals from which practically all pertinent taxonomic data have been excerpted, either by clipping or by typing, are complete sets of the following:

Bulletin de l'herbier Boissier; Journal of Botany, British and Foreign; Kew Bulletin of Miscellaneous Information; Notes from the Royal Botanic Garden, Edinburgh; Notizblatt des Botanischen Gartens und Museums, Berlin; Linnaea; Philippine Journal of Science; Sunyatsenia; Sinensia; Lingnan Science Journal; publications of the Fan Memorial Institute of Biology, Metropolitan Museum (Academia Sinica), Science Society of China, and the Peking Natural History Society; Bulletin de la Société botanique de France, Notulae Systematicae (Paris), Notulae Systematicae (Leningrad), Bishop Museum publications in botany; Field Museum publications in botany; nearly all of the official publications of the botanical garden, Buitenzorg; all of the official publications of the New York Botanical Garden, including the North American Flora; Records of the Botanical Survey of India; Annals of the Missouri Botanical Garden; Contributions from the Gray Herbarium; Contribu-[175]tions from the United States National Herbarium; Journal of the Arnold Arboretum; the Hookerian series of botanical periodicals preceding the establishment of the Journal of Botany, British and Foreign; Hooker's Icones Plantarum (the first ten volumes reproduced by photostat); Proceedings of the Biological Society of Washington; Mededeelingen van 'sRijks Herbarium, Leiden; Bulletin mensuel de la Société Linnéenne de Paris; Bulletin du Muséum d'histoire naturelle (Paris); Bulletin de l'Académie internationale de géographie botanique; Acta Horti Gothoburgensis; Candollea; Annuaire du Conservatoire et du Jardin botaniques de Genève; Gentes herbarum; Transactions of the Linnean Society, University of California Publications, Botany and others.

Much of the systematic data have also been excerpted from another long series of periodicals, including the Botanische Jahrbücher, Fedde's Repertorium and its Beihefte, Beihefte zum Botanischen Centralblatt, Annales des sciences naturelles, Le monde des plantes, Botanical Gazette, Bulletin of the Torrey Botanical Club, Rhodora, Acta Horti Petropolitani, Gardeners' Chronicle, Botanische Zeitung, Bonplandia, Hedwigia, Journal de botanique (Morot), Flora, Journal of the Washington Academy of Science, Bulletin de la Société impériale des naturalistes de Moscou, Mededeelingen van het Botanisch Museum en Herbarium van de Rijks Universiteit te Utrecht, and scattered articles in a large number of other periodicals.

Supplementing these data, many thousands of clippings were prepared

from miscellaneous reprints from a wide variety of sources, various modern and even some older monographs, independently published volumes, the numerous original descriptions in Kuntze's Revisio generum plantarum, and from such extensive works as those of Maximowicz on the floras of Japan and Manchuria, and the more recent ones of Handel-Mazzetti on the flora of China, Plantae Wilsonianae and similar works. The work is still being continued, now supported by federal and state relief funds.

The hundreds of thousands of items from sources indicated above, some the original printed data, some typed copies, some reproduced by the photostat method, are actually incorporated in the herbarium of the New York Botanical Garden, thus making this great reference collection a most outstanding one in which resident and visiting investigators can prosecute intensive work without the great loss of time entailed in other institutions where a very high percentage of one's time must of necessity be devoted to library search. Under this system, the library to a remarkable degree has been made an actual part of the herbarium, with [176] original descriptions, critical notes, illustrations, redescriptions, extensions of ranges, etc., actually associated with the reference specimens. Here in many groups, and for almost entire floras in some cases, the systematist finds before him practically everything that he needs in the way of the printed record, without the necessity of having, in each case, to spend hours, or days, or even weeks, searching for the needed references in the tremendously scattered source literature that he may need to consult in connection with the problem under investigation. In other words, within limits, the herbarium is not only an herbarium in the generally accepted sense, but it is an herbarium, a card catalogue and a library, all combined in one working unit.

Since this large scale work was undertaken, first at the University of California in 1923, later at the New York Botanical Garden in 1930, and more recently at the Arnold Arboretum, modifications or adaptations of the same idea have been adopted at the United States National Herbarium, the Philadelphia Academy of Natural Sciences, and at several institutions in China. To make currently published data available for this purpose special editions of certain periodicals are now being issued, printed on one side of the paper only, such as "Sunyatsenia," the Berlin "Notizblatt" and Fedde's "Repertorium"; to this short list is now added the "Journal of the Arnold Arboretum." In the past at least some parts of "Das Pflanzenreich" have been so printed in limited editions.

There is little agreement as to how such data should be incorporated into the herbarium. When I first commenced inserting occasional descriptions into the herbarium many years ago, they were automatically treated like herbarium specimens, and mounted on standard herbarium sheets. Occasionally they were pasted on the sheet bearing the type specimen. These are apparently the first methods that one thinks of. Both have certain obvious and serious disadvantages. I then developed the idea of pasting the description inside of the specimen cover so that in studying the included botanical material, one would have both the description and the specimen or specimens before him. Soon this scheme was found to be faulty and it was quickly abandoned for the one adopted

at California, New York, and the Arnold Arboretum, i.e., to paste the description or the clipping rather lightly by its corners on the outside of the specimen cover, on the lower left hand corner of the folded sheet.

A serious objection to mounting single descriptions in the middle of a standard herbarium sheet, aside from the relatively high cost of mounting paper, is that such a sheet may become misplaced among the mounted specimens. In any case, if the first sheet of a series bears [177] merely a printed or typed description it effectively obscures the actual specimens, a point that needs consideration when one is making hurried comparisons. If the slips are firmly pasted, as unfortunately they are in most cases, they cannot be easily removed. Again, if they are placed in the middle of a standard sheet, as is usually the case, there is inadequate space for adding other descriptions, such as those of species reduced to synonymy, redescriptions, and later critical notes; for such data as well as for original descriptions of species reduced to synonymy, one is forced to use an extra sheet for each. One could site cases, where with one description to a sheet it might conceivably be necessary to prepare and insert not one or two or three sheets, but literally scores of them, for many "recognized" species are burdened with scores of synonyms. This system, consistently followed, adds a tremendous amount of needless paper to the herbarium and results in a very great waste of expensive herbarium storage space. The chief objection to pasting an original description on the type sheet itself, is that frequently adequate space is not available unless a part of the specimen itself be obscured by the clippings.

The reason I soon abandoned pasting the descriptions on the inside of the cover was because hurried or careless herbarium workers tended to discard frayed, torn, or stained covers without glancing inside to see whether or not there were contained data in the form of clippings or typed descriptions. Specimen covers that contain no data other than a description pasted on the inside are particularly apt to be discarded, for without glancing inside, one cannot determine whether or not there are included clippings.

Having stated some of the serious objections to the first two methods, it is well to indicate the advantages of the third method with which I have now had over twelve years' experience, and not one based on a limited, or even a local use of the system, but rather with a world viewpoint, involving hundreds of thousands of items. As indicated above, one of the consistent criticisms of any method of making these herbarium inserts has been that it "adds too much paper" to the herbarium. With the herbarium sheet method I agree fully with this criticism. With the specimen cover system, utilizing a rather thin, tough, durable paper, such as Nibroc Duracel 40 lbs., and adding from one to many clippings to a single sheet, no just criticism can be made, for the space taken does not equal that needed for a single average mounted botanical specimen. The system, however, does involve the acceptance of the specimen cover plan, i.e., all sheets of a single species to be included in a single thin cover within the stiffer genus cover; few to many specimen covers [178] with their included sheets may be inserted within a single genus cover. If this be adding too much paper, then the specimen cover system is condemned at the outset by individuals, perhaps, who have never used it. The specimen

covers serve another purpose in that they very greatly protect mounted specimens from undue breakage.

In practice a high percentage of the sheets will have but a single description, this the original one. For common, widely distributed, and variable species, and especially those that have a complicated synonymy, the sheets will eventually bear from two or three to very numerous items. The first item should be placed about a half inch above the lower margin in the left hand corner of the folded sheet, lightly gummed by the corners only. Additional items are added in sequence of their preparation above the first one. To the same sheet should be attached original descriptions of species that have been reduced, if such occur, as is frequently the case. To the sheet should also be attached redescriptions, critical considerations by later authors, and especially those items that contain literature references, synonymy, and important extensions of range; in fact, all pertinent data of importance that may have been published by various authors that appertain to the species under consideration. In extreme cases a sheet may be so thoroughly covered by supplementary published data of one type or another that all available space is taken. In this case a single sheet of the same stock as the specimen cover may be utilized for the overflow, this to be inserted inside the first cover. As incorporated material relating to supposedly distinct species is found to appertain to a single species, the two covers may be "telescoped" one within the other, or the data may be removed from one sheet and attached to the other.

This brings up a most important point for those who use either the herbarium sheet method, or the species cover system. The clippings should not be pasted firmly to the carrying medium under any circumstances, but rather they should be pasted lightly by their corners so that, as necessary, they may readily be removed for transfer to other positions. Only narrow strips, that might be easily torn if pasted only by their ends, should receive more adhesive. This is a most important point and any curator adopting this clipping system or any modification of it, should give careful consideration to the simple problem of attaching the slips before a system has been adopted that may eventually be found to be very disadvantageous. Whether typed data be attached to standard herbarium sheets or to specimen covers, they should be prepared on thin paper of good quality, such as onion skin paper rather than on the heavier standard paper, this to save space in the storage [179] cases, for when one contemplates the addition of tens of thousands of typed entries into the herbarium, the problem of space becomes distinctly important.

The general and preferred method of preparing clippings is to take two copies of the work to be clipped, arrange the sheets as page proof, and to each entry add in the text or at the margin, an abbreviated but clear reference to the author, periodical or title, volume, page and date; these to be either typed, written long hand, or stamped. For standard periodical references the citations may be greatly abbreviated, such as JOB. instead of Journ. Bot.; BG. instead of Bot. Gaz.; BJ. instead of Bot. Jahrb.; KB. instead of Kew Bull.; BTBC. instead of Bull. Torr. Bot. Club; and JLSB. instead of Journ. Linn. Soc. Bot. When only one copy of a paper desirable for clipping is available, every other page must be typed, photographed or photostated, the citations to be added as part of

the typing task. For older periodicals, rare items, and important articles where reprints are unavailable, all entries should be typed. In some cases entire volumes may be reproduced by the photostat method and these sheets then clipped. Obviously the original printed data or a photographic reproduction of it, is preferable to a typed copy.

When a sufficient number of clippings or typed slips are available, they are systematized by families and genera, and then inserted into the herbarium in their proper places. Normally the best procedure to follow is for some botanist familiar with the flora, or the group, to examine the entries and indicate obvious reductions to synonymy, thus avoiding the undue scattering of items appertaining to a single species under different names in the herbarium.

In special cases, such as the preparation of a monographic work or a revision of a special group, all original descriptions and critical notes for every species may be prepared. This, however, involves a very great amount of bibliographic work, other than straight routine, and generally involves a considerable amount of supervisory time by staff members, the ordinary routine employee not being equipped to find the references needed. On the whole this method of compiling data is wasteful in the extreme, and is in general impracticable unless a trained botanist be willing and ready to devote a very large amount of time to the project.

Some curators who have recently adopted this plan restrict their herbarium insertions to copies of original descriptions. From my standpoint, and based on my own extensive experience, while this is better than nothing, yet a serious error is made in not including data where synonymy with literature references and citations of specimens are given. Not infrequently a later author's consideration of a species is [180] distinctly more illuminating than is the original description. It is particularly important that all pertinent additional data, redescriptions, critical notes, supplementary data on type specimens, and significant extensions of range be preserved and incorporated on the sheet or sheets with the original description. Except in those cases where new names appear in current literature, important published data may be entirely overlooked, for manifestly it is impossible for the average botanist to master and keep in mind the tens of thousands widely scattered and unindexed observations. References check against each other, and automatically in examining long series of assembled data regarding this or that species, one often detects errors, some perhaps relatively unimportant, but frequently most exasperating, particularly when they include incorrect volume numbers, page references, dates of publication, and occasionally even wrong periodical titles; many botanists apparently do not check their cited references on the originals, and an error once made in a standard work may automatically be repeated over and over again. When discrepancies are noted in a series of published references, it is a simple matter to determine which is correct by consulting the original publication. As a side issue to this work scores of binomials overlooked by the compilers of Index Kewensis and its supplements were detected.

So much of the criticism of the principle of making herbarium inserts has come from individuals unfamiliar with its extensive recent development in a few institutions that I have become impervious to it. To early

criticisms to the effect that the scheme was impracticable, I believe that it has been abundantly proved that the reverse is the case. To those who criticize without the basis of actual experience little attention need be given. To those who utilize the data and then criticize the system because not all the needed and published data have been incorporated, or because some non-technical assistant has filed a reference in the wrong place, the answer is obvious; cooperate in helping to complete the records. Those interested in the printed page may look on me as a vandal, because annually I clip many hundreds of pages of technical descriptions. If a library has a complete set of a periodical, I see little reason for considering that all reprints from that periodical are sacred and must be maintained on the shelves as separate items. I frankly believe that frequently the best place for the reprint is in the herbarium in association with the plants to which the data appertain rather than on the library shelf.

One great handicap is the attitude of the average herbarium worker. He has so much productive work to accomplish that he cannot afford [181] to take the time to prosecute the necessary routine in preparing and inserting herbarium clippings covering his own contributions much less those of numerous other botanists. He forgets that what is accomplished is of benefit not only to himself but to all who in the future may have occasion to utilize the herbarium reference facilities, and that what he accomplishes, no matter how little, is a contribution to the efficiency of his own future work as well as to the efficiency of others.

When one is dealing with the problems of identification of collections coming from little known parts of the world, particularly from areas not covered by published floras or even systematic lists, one must of necessity spend a disproportionate part of his time locating the widely scattered published descriptions and critical notes, which he must, or at least should, consult and compare critically with his material. To find these data assembled and arranged in advance, and actually in the herbarium, whether specimens representing the named species are available or not, adds tremendously to one's efficiency and should tend to more accurate, complete, and dependable work.

After over twelve years' experience with this innovation in herbarium practice and particularly with the large scale demonstration as developed at the New York Botanical Garden I became more and more enthusiastic regarding its merits as the increasing number of references *in situ* in the herbarium demonstrate its extreme utility. I feel safe in asserting that no large herbarium can safely ignore the challenge and avoid the issue of incorporating in its working collections at least those current items published by its own staff members. I am convinced that this innovation is one of the most important advances made in herbarium technique in the last few decades. Objections invariably come from individuals long accustomed to standard, or better, static technique. They claim that the work cannot be done with their present resources; that of the specimens, the literature in the form of a library, and comprehensive indices are available, it is not necessary to take the time to incorporate such data in the herbarium; that the plan involves putting too much paper into the herbarium; that they have too much productive work to do to warrant taking the time to accomplish this routine task; and (never

having done it) they believe that it is impracticable. These are some of the current but invalid objections.

Several years ago when I was directing the work of several typists engaged solely in copying original descriptions from the older literature, the curator of one of our large herbaria courteously but firmly declined to accept my offer to supply him gratis with a carbon copy of each description thus reproduced. He had access to extensive herbarium [182] facilities, to a great botanical library, and to comprehensive indices and card catalogues, and could see little to be gained by having the original descriptions incorporated in the herbarium. How many thousands of steps might have been saved within a single year, and how much time have been conserved in the endless consulting of hundreds or even thousands of descriptions in the library made no impression. In searching for objections to an obviously important innovation the average herbarium executive, handicapped by a long established and static routine, forgets that those who come after him will not have his intensive knowledge of a special flora, a special group, or of a special literature, but that each worker must, to a certain degree, forge his own tools. The work of all future investigators is made infinitely easier if the current worker would but incorporate, from time to time, in association with the specimens, at least his more important contributions. It is noteworthy how objections fade when a botanist accustomed to the old method of botanical specimens plus a card-catalogue or an index, plus a library, borrows all the material in a special group, specimens and covers with incorporated printed or typed data, from an institution in which the system has been well established, and finds to his surprise that his bibliography for this or that group is largely done for him; that he has before him most of the published descriptions he needs, whether represented by authentically named specimens or not; and not infrequently he finds references from obscure sources of which he had no previous knowledge.

ON THE SIGNIFICANCE OF CERTAIN ORIENTAL PLANT NAMES IN RELATION TO INTRODUCED SPECIES*

[112] There is a great wealth of philological material in the aboriginal plant names recorded in association with the Latin binomials used under the binary system to designate individual plant species.[1] A high percentage of such names, within limited geographic areas, particularly in such parts of the world as India, Malaysia, including the Philippines, and Polynesia, are really safe guides to the identification of genera, species, and even varieties. Very many of them are even more fixed, as designating certain definite units, than are many of our Latin binomials. They have been used for many centuries to indicate definite species and will be used for many centuries to come, regardless of the vagaries of the binomial system. They are not [113] changed because of priority, because of varying conceptions of what constitutes a genus or a species, or because of the personal idiosyncrasies of this or that botanist, but persist generation after generation as definite designations for definite plant forms; some are of very local application, others are applied to the same species over a very wide geographic range.

Comparative philologists have made little use of these data, probably for the reason that the average worker in that field has lacked the intensive botanical knowledge properly to select significant species for study among the tens of thousands of described ones, and perhaps also because they have been repelled by the very large number of recorded native plant names. In the general field of philology, for the purposes of comparison, it has been simpler, and perhaps just as effective from the standpoint of those interested in the relationships of languages, to compile lists of conspicuous objects such as the sun, moon, stars, water, parts of the human body, numerals, certain verbs and other words.

* E. D. Merrill, "On the Significance of certain Oriental Plant Names in relation to Introduced Species" (Proceedings of the American Philosophical Society 78: 112-146, 1937).

[1] Some of the sources of information of Indian, Malaysian, and Philippine plant names are given below. Most of the Polynesian and Micronesian names cited were compiled from my manuscript card catalogue of Polynesian plants.

Burkill, I. H. A Dictionary of the Economic Products of the Malay Peninsula, **1**: i-xi. 1-1220; **2**: 1221-2402. 1935.

Clercq, F. S., and Greshoff, M. Nieuw Plantkundig Woordenboek voor Nederlandsch Indië, i-xxi. 1-385. 1909.

Heyne, K. De nuttige Planten van Nederlandsch-Indië, **1**: [1-2] 1-510. i-lxxx. 1914 (Reprinted 1922); **2**: 1-349. i-xxxix. 1916; **3**: 1-402. i-xlviii. 1917; **4**: 1-254. i-xxxvi. 1917. Ed. 2, **1**: 1-2, 1-732; **2**: 733-1450; **3**: 1451-1662. i-ccxli. 1927.

Merrill, E. D. An Enumeration of Philippine Flowering Plants, **1**: i-vii. 1-463. 1922-25; **2**: 1-530. 1923; **3**: 1-628. 1923; **4**: 1-515. *t. 1-6. f. 1-3.* 1926.

Ridley, H. N. The Flora of the Malay Peninsula, **1**: i-xxxv. 1-918. *f. 1-75.* 1922; **2**: i-vi. 1-672. *f. 76-131.* 1923; **3**: i-vi. 1-406, *f. 132-159.* 1924; **4**: 1-383. *f. 160-209.* 1924; **5**: 1-470. *f. 210-229.* 1925.

Watt, G. A Dictionary of the Economic Products of India, **1** (1885)-**6** (1893). Index 1-165. 1896.

In this day of specialization, it is scarcely to be expected that many botanists will delve into the intricacies of anthropology, archeology, and comparative philology, or that many specialists in these fields will master even the rudiments of systematic botany. Yet individuals working in these diverse fields can be of mutual assistance to each other. Cases may be cited where taxonomists have misinterpreted the botanical evidence as to the place of origin of cultivated species, such as in accrediting the cultivated cucurbitas to Asia; yet the archeological data absolutely supports the phytogeographical evidence that these plants originated in America. One erroneously assumed that tobacco must have been native of Africa and "proved" that this was the case, in spite of the botanical evidence that is overwhelmingly in support of its American origin. Another insisted that the smoking of tobacco originated independently in New Guinea on the basis of a native species [114] of tobacco, yet there is no botanical evidence that any tobacco species occurred in New Guinea before the period of European contacts, while the one species that does grow there, *Nicotiana tabacum*, is of hybrid and indubitably of American origin. One "proves" that the coconut was a native of the New World and that it must have been transmitted across the Pacific at a very early time by man, and another definitely shows that the whole concept and argument was erroneous and that in all probability the coconut did not even occur in tropical America in pre-Columbian times, and that it was first introduced by the Portuguese into Brazil and a little later by the Spaniards into Mexico.

The average botanist usually has no knowledge of and little interest in comparative philology, or is too busy with the multitudinous problems within his own field to master the rudiments of it or to assemble and to attempt to interpret the significance of this or that series of cognate forms even among those names applied to the basic cultivated species. He may realize that in all countries where agriculture is practiced that many of the cultivated species, and the weeds of cultivation, are exotics. He may realize further that some of these plants were disseminated at a relatively early date in the history of the human race, many of them in prehistoric times, others within the historic period, particularly following the expansion of the European colonizing nations after the middle ages. He often does not fully realize that the boundaries of the one hemisphere or the other were the actual limits to the diffusion of cultivated plants originating in America or in Eurasia and that a general interchange of these economic plants between the two hemispheres did not occur until after the first circumnavigation of the globe by Magellan in 1520.

With no claims to other than a very superficial knowledge of comparative philology and with no training whatever in this field, I have had the temerity to compile certain lists of native plant names with the conviction that in this field we have a source of information that will yield impor-[115]tant results to both the philologist and the botanist, and more particularly to those individuals who are interested in the origin, history, and the approximate time of dispersal, and the early limits to dissemination of cultivated plants. I have done this with the full realization that I may be accused of selecting a subject regarding which I know nothing, and again because I may err in drawing conclusions that perhaps a professional com-

parative philologist might not accept. In the utilization of the philological data one may misinterpret the significance of this or that name, and occasionally one may include words or forms of words that perhaps should not be cited.

If one examines the long lists of plant names recorded from India, Malaysia, the Philippines, Micronesia, and Polynesia, one is impressed with the fact that for the endemic species and those of limited geographic distribution the local names are mostly what we may designate as autochthonous; that is, names characteristic of local languages or dialects and used specifically to designate this or that natural group, usually a species, sometimes applied in a generic sense, sometimes even used in a varietal sense. Sometimes one finds cognate forms of a single word, not infrequently with myriads of variants, very widely used to designate species of manifestly natural distribution. Again one notes that another term, or cognate forms of it, may be used over vast areas—and we may cite Madagascar, across Malaysia and Polynesia to Hawaii and the Marquesas Islands—to designate certain universally distributed cultivated species, the plant manifestly for the most part man-distributed. In these two cases it seems only reasonable to assume that for the non-cultivated plant of natural wide distribution, the name was carried by an early expanding people and automatically applied to the species, known to them in their original home land, as it was observed in the new lands occupied by them. With the man-distributed cultivated plants it seems to be likewise logical to assume that the plant itself, with its original name, was actually [116] distributed by an expanding people, or the plant and its name was passed from one group to another by diffusion.

In addition to the three categories mentioned above one notes still another, that is, a series of borrowed or adapted names applied to introduced species. And when a cultivated or naturalized plant is found in a region remote from its original home such names become distinctly significant as to when, by whom, and how such plants were originally introduced. Borrowed names again fall into two categories, those actually taken from strictly foreign languages, some in historic, some in pre-historic times, and those adapted from the name of some other species, usually by the addition of modifying words, because of some similarity or assumed similarity between the introduced plant and a native or earlier introduced one.

To illustrate these points data have been compiled on the local names of the coconut (*Cocos nucifera* Linn.) from Madagascar to Hawaii, *Hibiscus tiliaceus* Linn., over the same range, and the frangipanni (*Plumeria acuminata* Ait.) from Mexico, its original home, and from the Indo-Malaysian region where it is a common introduced plant. Supplementing these data and further to support the idea that native plant names are worthy of a more intensive study than they have hitherto received, I have compiled lists of Sanskritic, Chinese, and Nahautl (Mexican) names currently used in the Philippines and in Malaysia to designate certain definite and for the most part introduced and cultivated species.

To explain the occurrence of these names thousands of miles away from their places of origin certain historical data are given appertaining to contacts in ancient and in comparatively recent times. These data are pre-

sented for what they are worth. The conclusions are my own, subject to corrections and extensions that others may suggest. Too frequently comparative data, of the type under discussion, have been used to bolster up often illogical preconceived theories. Merely because there are Sanskritic, [117] Chinese, and Nahautl plant names in current use in Malaysia and in the Philippines is no evidence whatever of affinities between the languages of India, China, and Mexico, with those of Malaysia, for there are no genetic relationships between the diverse languages involved. Such names in the insular area discussed are merely borrowed ones, or introduced with the plants themselves. It is, however, important that we should know approximately when they were introduced. Again merely because there may be occasional similarities between certain plant names used in America with some used in the Old World is, in most cases, little reason for concluding that there were ancient contacts between the early peoples in these widely separated regions; sometimes similarities are merely accidental, sometimes they may be explained by historical contacts.

As evidence the comparative philology of plant names must be used with restraint and caution. When, however, there is a general agreement in plant names with other data, historical, biological, and otherwise, then we can accept the evidence as supporting this or that conclusion. Factors to be considered are what is known regarding expanding and colonizing peoples in ancient and in relatively modern times, what light modern archeology throws on the problem or problems, what we may learn from the annals of history and exploration, and what the taxonomy and phytogeography of plants in general teaches us. We are not justified when we merely select certain facts that support a preconceived theory and ignore those data that are opposed to it. To be effective and convincing conclusions must be logical ones. When illogical arguments are supported by citing only those data favoring the contention or contentions and ignoring the known facts that are opposed to the theory, the well known method of half truths, then we should look on such papers as contributions to the field of imaginative fiction, perhaps interesting as fiction but not to be considered seriously. In general philological evi-[118]dence is of distinct value when the conclusions that we may draw from a consideration of such data are in conformity with the known biological facts of plant distribution.

THE COCONUT

The actual place of origin of this plant is somewhat of a mystery although it is indubitably native of some part of the Old World tropics. The tribe or subfamily, Cocoinæ, to which *Cocos* belongs, is predominantly characteristic of tropical America, with the genera *Attalea, Maximiliana, Diplothemium, Jubæa, Orbignya,* and *Arecastrum, Butia,* and *Glaziova,* narrow segregates from *Cocos* in tropical America, *Elæis* in tropical Africa, *Jubæopsis* in southeastern Africa, and *Cocos,* now pantropic in cultivation. The reference of numerous native tropical American species of *Arecastrum, Butia,* and *Glaziova* to *Cocos* has confused the issue. Assuming that Bentham and Hooker's and Drude's concept of *Cocos* as a genus, *sensu latiore,* be correct, then it would be surprising if all the wild species of a considerable genus should be natives of tropical America, and the one widely cultivated

species dominant in the Old World and not an indigenous plant in America. This classification and this distribution was apparently the chief basis of Cook's[2] illogical attempt to prove the American origin of *Cocos nucifera* Linn. It is apparent that he accepted current classification as correct.

Beccari[3] called attention to the fact that *Jubæopsis caffra* Becc. of southeastern Africa has many more affinities with *Cocos nucifera* Linn. than has any other known palm among those hitherto referred by authors to the genus *Cocos*. After carefully examining the characters of the groups involved he expressed the opinion that it would be better to regard *Arecastrum, Butia,* and *Glaziova* as of [119] generic rank, rather than as subgenera of *Cocos; Arecastrum* with two or, at most, few species, *Butia* with ten to twelve or more species, and *Glaziova* with more than forty species, all in tropical America. With this disposition of the American so-called species of *Cocos,* the latter genus stands as monotypic, with a single species, *Cocos nucifera* Linn., and with its closest ally the monotypic *Jubæopsis* confined to southeastern Africa. In favor of an Old World origin of *Cocos* is also Hill's[4] record of fossil *Cocos* nuts from New Zealand. For an extensive and critical consideration of the problem of American versus Old World origin of the coconut see Chiovenda.[5]

Cook's argument in general was that the coconut originated in some part of tropical America; that it was an inland species, which is incredible; and that it was an early introduction into Polynesia by prehistoric voyagers from America, which is also incredible and for which absolutely no proof exists. His general statement is a convincing one in support of his contention, but unfortunately he overstressed the factors that tended to support his preconceived theory and understressed or ignored those that were opposed to it.

Without dissecting Cook's argument in detail, I wish to discuss two points other than the philological one. As against possible dissemination of the coconut by ocean currents he argues that the chances are hundreds to one that coconuts falling into the water will be thrown back immediately upon their own coast like other objects floating in the surf and definitely says: "High waves or tides, instead of floating shore debris away, merely carry it farther inland, *as everybody familiar with seacoasts knows*" (italics mine). What about an off-shore wind and an outflowing tide? What about the situation at the ends or on the lee of small islands? What about estuarine conditions with [120] a strong outflowing current? On the basis of Cook's statement how could one possibly account for the wide distribution of strand plants that are adapted to dissemination by floating seeds or fruits? How could seeds and fruits, including coconuts, and floating debris in abundance, reach isolated sand bars and slightly raised reefs that support

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[2] **Cook, O. F.** The Origin and Distribution of the Cocoa Palm. Contr. U. S. Nat. Herb., **7**: 257-293. 1901. History of the Coconut Palm in America. Contr. U. S. Nat. Herb., **14**: 271-342. i-xii. *t. 53-66.* 1910.

[3] **Beccari, O.** The Origin and Dispersal of Cocos nucifera. Philip. Jour. Sci., **12**: Bot. 27-43. 1917.

[4] **Hill, A. W.** The Original Home and Mode of Dispersal of the Coconut. Nature, **124**: 133. 1929.

[5] **Chiovenda, E.** La culla del Cocco. Contributo alla ricerca della patria originaria della Palma del Cocco. Webbia **5**: 199-294. 1921; 359-449. 1923.

no vegetation because at times they are entirely flooded or swept by heavy waves? How about floating debris in abundance that one notes at certain times far from land in such a region as the Malay Archipelago?

The categorical statement is made that numerous economic plants including the sweet potato, the bottle gourd (*Lagenaria*), the true gourd (*Cucurbita*), cowhage (*Mucuna*), yam bean (*Pachyrhizus*), and one or more species of yams (*Dioscorea*), all probably of American origin, existed in Polynesia and in the Malay region in prehistoric times. For the sake of argument we may admit that these plants were native of some part of America, but only one, the unimportant bottle gourd (*Lagenaria*), seems definitely to have been of pantropic distribution in prehistoric times. It is probable, or at least possible, that the sweet potato reached Polynesia from America[6] in pre-Magellan times. Burkill,[7] however, effectively shows that on the basis of its Malay names, which are all borrowed ones, that it is a late introduction into the Malay Archipelago. The Old World true gourd records were undoubtedly based on erroneous determinations or confusion as between the true gourd and some other cucurbitaceous plant. The cowhage, *i.e.*, the form with stinging hairs on its pods, is not an edible or even a cultivated plant. I know of no records that would indicate the occurrence of the yam bean in the Old World until after it was introduced there by the Europeans, nor do I know of any data that would prove that any cultivated yam had this distribution in prehistoric times. The "nu-[121] merous economic plants" of prehistoric pantropic distribution, stressed by Cook, seem to be conspicuous by their absence. In this connection Cook states that the banana was introduced into America in prehistoric times, but the bulk of the evidence is utterly opposed to this assumption, and the probability is that it was first introduced by the Portuguese via the Cape Verde Islands.

It is admitted that some botanists argue for at least a limited interchange of neotropic and palæotropic plants across the Pacific in pre-Magellan times. However, it is notable that the arguments supporting the contention that the banana and the coconut were of pre-Columbian occurrence in America are of the most nebulous character and are far from convincing, and the suggested pre-Columbian occurrence of Old World species in America generally stop with these two plants. If two species were so introduced, why not many more?

It has been suggested that various plants of American origin also occurred in the Polynesian-Malaysian region in pre-Magellan times, but here again there is little tangible evidence to support such contentions. In general in reference to these supposedly early plant immigrants from America to Malaysia one is impressed by the relative unimportance of the species for which such claims are made. Why should a tree useful only for ornamental purposes, such as the *Plumeria,* or one of very slight economic importance, such as the *Ceiba,* be selected for dissemination by early or even fairly late civilized man when one would naturally expect to find important food plants preferred, such as maize, the garden, field, and lima

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[6] **Dixon, R. B.** The Problem of the Sweet Potato in Polynesia. Am. Anthropol., **34:** 40-66. 1932.

[7] **Burkill, I. H.** Dictionary of the Economic Products of the Malay Peninsula **2:** 1246. 1935.

beans, yautia, tomato, peanut, cassava, squash, pumpkin, pepper, and others? These in competition with the suggested non-economics failed to make the passage.

It is difficult to prove just when certain neotropical plants reached the palæotropical regions and vice versa. It is, however, manifest that most if not all of the really important species failed to make the passage until after the [122] Europeans commenced to make trans-Pacific voyages. I know of no single case of supposedly pre-Magellan introduction one way or the other that is susceptible of definite proof. Conclusions based on early published fragmentary records are often of doubtful significance because of the simple fact that positive identification is usually impossible from the totally inadequate data recorded. Misidentification is more apt to be the explanation of the supposed occurrence of this or that cultivated plant far "out of range" at an early date.

Cook, apparently to support a preconceived theory of American origin of agriculture and a very early dissemination of economic plants across Polynesia by ocean-going peoples sailing from America, claims that a considerable number of American plants in the Old World support this idea, but my general conclusion is that American plants in the Polynesian-Malaysian regions in pre-Magellan times were more conspicuous by their absence than by their presence in the Old World tropics.

Cook's philological argument supporting an assumed American origin of the coconut is exceedingly weak. How should we interpret these data? He admitted that the lack of native American names had been accepted as proof that the palm could not have existed in America before the arrival of the Spaniards, and then proceeds to set up the remarkable theory that probably the word "coco" itself is of American origin. It is true that the word is used in America for designating certain plants, but for nothing in aboriginal languages at all resembling the coconut. That the word is a favorite plant name in several Central American languages applied particularly to plants that have bulbs or bulbous roots, is no argument in support of this name being applied to such a totally different plant as the coconut palm. What weight should be placed on the suggestion that a Tupi Indian name in Brazil, *nha,* there applied to the Brazil nut tree, *Bertholletia excelsea,* has anything whatever to do with the Polynesian name *niu* applied [123] to the coconut? And yet Cook makes the most extraordinary statement: "The agreement and distribution of the Polynesian, Melanesian, Malayan and other Oriental names of the coconut indicates a westward migration for the race which introduced it in the western Pacific."

Contrasted to the situation in America the names of the coconut in the Old World tropics are myriad, but I see no reason for considering that any of them are to be associated in any way with vernacular names in America, except as the word *coco* itself has been adopted in most parts of America, introduced by the Portuguese and the Spaniards with the plant itself. In this connection Bartlett[8] gives excellent reasons for believing that the word *coco* is not, as generally supposed, a word of European origin from the Portuguese *coco* (a bugbear or an ugly mask), but that it was perhaps adopted by the early Portuguese explorers in the orient from its Turkish

[8] **Bartlett, H. H. Papers Michigan Acad. Sci., 6: 16-17. 1927.**

name *cock-indi* more or less spread in Malaysia by the Arab traders, quoting Rumphius' opinion, written 1670, or somewhat earlier, in support of his contention. Forms actually cited in the early European literature appertaining to the coconut in the Old World tropics include *coquos* and *quoquos,* both plural, *coco,* and *coquo.* Forms actually used in various parts of Malaysia at an early date include *kokær, coker, igo, calucu,* and *lalucco,* the last three from Rumphius; and I am inclined to agree with Bartlett in his expressed opinion that these last Indonesian names are not modern adaptations of the Europeanized *coco,* for they were recorded not later than 1670.

The various words used to designate the coconut in India and Malaysia are very numerous, but fall into several distinct categories of apparently unrelated names. It is entirely reasonable to suppose that the most widely dispersed one, the *niue-nia-niu-niog* series, is the oldest. In various forms this extends from Madagascar to parts of India, through Malaysia and the Philippines, Micronesia, [124] and Melanesia, to the extreme eastern limits of Polynesia, Hawaii and the Marquesas Islands. Without attempting to list all the variants, or to indicate always where the several forms are used, the following list is impressive. *Nyiur, nyor, niyu, nia* (Malay Peninsula); *nuir, niue* (Sumatra); *njijor, njijær, njor, ijor, enhor* (Java); *niël* (Ceram); *njæ* (Bali), and numerous other variants used in various parts of the Malay Archipelago such as *njær, nijæ, nijær, nijol, nikwel, nimel, nimelo, nio, niæ, niæra, niæi, niwe, niwel, niwer, njejong, njejor, nhir, nihiwe, njæh, njor, noa, næra, næwolo, noö, noör, noöra, noro, æ, ær, ohi, onjæ,* etc. Going farther afield we find *wau-niu* and *voa-niu* in Madagascar (the name probably introduced with the plant itself by invading Indonesian peoples). In India, *narel, nariyal, nariel, narikel, nariyaland, narikela,* and numerous other forms apparently derived from the Sanskritic *narjil.* In New Guinea *næ ajo* is recorded, in the New Hebrides *maru,* and in New Caledonia *nu.* In the Philippines the coconut is universally known from north to south as *niog.* And in various parts of Polynesia we find again the constant occurrence of this same root in such names as *niu* (Fiji, Samoa, Tahiti, Hawaii, Yap, Makatea), *nia* (Tahiti), *nu* (Truk, Rarotonga), *ni* (Ponape), *nius* (Palau), *niyog* (Guam), indicating a reasonably universal use of slight variants of one name all over Micronesia and Polynesia. I have no records of radically different names for this palm from any part of the Micronesian-Polynesian region.

There are several other series of coconut names that apparently have nothing to do with the *niue-nia-niu-niog* series, which it does not seem necessary to discuss in detail here. They are the *halambir-kelambir* series with such variants as *karambil, krambel, krambil, karambie, ketjambil* in the Malay Peninsula, Sumatra, Java, and neighboring small islands. The *kalapa* series with such variants as *klapa, kelapa, kelapo,* is largely used in Java. Other series could be built up from the Persian *pol,* the Singalese *ong,* and the *pankoi-peirol-pænæ* series in Celebes and neighbor-[125]ing islands. In all these, other than the *niue-nia-niu-niog* series, the use of the names is invariably restricted to limited geographic areas, rather clearly indicating that these names became current later than the *niu* series which extends from Madagascar to India through Malaysia and the Philippines to the eastern limits of Polynesia. Bartlett's conclusion is that in Malaysia

the *njijœr* series is the oldest, spread by early Indonesian peoples, that the *halambir-kelambir* series is next, having come into use much later than the *njijœr* series, and that the *kalapa* series is still younger than the *halambir-kelambir* one.

In this discussion I have not considered it necessary to list all the recorded oriental names of the coconut. De Clercq[9] records about 115 for the Netherlands East Indies with about 125 additional ones for recognized varieties, Heyne[10] in 1927 lists about 180 names from the same region, while Watt[11] records nearly 100 different names for British India. For tropical America Cook was able to record only *ko-ko* (which of course is Sp. *coco*), *sura no* and *sia ua* in Costa Rica, other than the ubiquitous *coco* introduced by the Spaniards and the Portuguese, while its even fewer Brazilian aboriginal names appear merely to be transfers of names of native palms to the coconut palm. Were the plant native of any part of tropical America or an early introduction from the Old World we might logically expect to find a very considerable number of vernacular names actually in use for it.

In view of the great paucity of colloquial names of the coconut in tropical America, and the enormous number in the Indo-Malaysian region, from the standpoint of comparative philology alone, ignoring other factors, the only conclusion that I can draw is diametrically opposed to that of Cook. It seems clear that the distribution of the coconut [126] was not from east to west, but definitely from west to east; that the name was disseminated with the plant itself, and that early migratory peoples were largely responsible for the spread of this palm in the Old World tropics, even as modern man was probably responsible for its introduction into tropical America, or at least for its wide distribution here. Ocean dispersal has also been a factor. The palm can maintain itself in favorable places without the aid of man. We may even admit its possible arrival on the west coast of tropical America in pre-Columbian times, but this does not alter the picture. If it were introduced there by natural means or by man, its introduction must have been consummated not long before the arrival of the Europeans; for if of ancient introduction, it would certainly have been quickly distributed by the natives by diffusion even as other economic plants of American origin were widely distributed within America in prehistoric times. One should not forget that invariably a plant of great economic importance, once introduced into a new region to which it is adapted, spreads with remarkable rapidity as witnessed by the fact that within twenty-five years after its introduction into Spain maize or Indian corn had reached western China via the then little travelled overland trade route from Asia Minor, doubtless the one actually travelled by Marco Polo.

The center of the great variation of the coconut, with the establishment of numerous recognizable varieties, and the center of the great development of its specific and varietal colloquial names is the Indo-Malaysian region of the Old World tropics.

[9] **Clercq, F. S. A. de,** and **Greshoff, M.** Nieuw Plantkundig Woordenboek voor Nederlandsch Indië, i-xxi. 1-395. 1909.

[10] **Heyne, K.** De Nuttige Planten van Nederlandsch Indië, ed. 2, **1:** 398-399. 1927.

[11] **Watt, G.** A Dictionary of the Plant Products of India, **2:** 415. 1889.

Plumeria acuminata Aiton

The genus *Plumeria,* with about 100 recognized species, is a group strictly confined to tropical America except as certain species have been introduced into other tropical countries for ornamental purposes. Among the plants figured by Plete from the bas reliefs of the twelfth century temple of Borobudur, Java, is one that Bakhuizen van den [127] Brink[12] in 1931 took to represent a *Plumeria,* although Cammerloher[13] does not include it in his slightly earlier consideration of the plant forms there depicted. Two years later Bakhuizen van den Brink[14] positively identified Plete's figure of the plant as the species now commonly known in many parts of Malaysia as *kambodja* = *Plumeria acuminata* Ait. If his identification be correct, all my argument is of no value for this would mean that this American plant occurred in Java in the twelfth century. His argument, other than his positive identification of the crude, greatly conventionalized bas relief on the Borobudur temple, is in general that the Malay name *kambodja* and those in the *tjempaka* series are Sanskritic in origin, which is manifestly true, and that such names as *bonga gulong tsjutsju, culong tsjutsju* and *culu tsjutsju* are of Malay origin, not corruptions of its Nahautl name *kalachuche* as modified in the Philippines. *Bonga* is of course the Malay name for flower. The other parts of these words he thinks may have been derived from the Malay *gelœng* = head dress or wreath, or *gœlœng* = to twist or roll up, or *golong* = roll, tube, and *sœsœ* = milk!

Intrigued by this explanation, I attempted to confirm its possibility by scanning all the entries in Heyne's work wherein are listed approximately 20,000 Malaysian plant names. There are many of these wherein the word *sœsœ* forms a part of the word, but in all of these I have detected no variants even approaching *tsjutsju.* In general the form *sœsœ* remains unchanged whether used as the first or the second part of a plant name. In the first case we find *sœsœ lopek* (*Codium tomentosum* Stackh.), *sœsœ mœnding* [128] (*Campanamœa javanica* Blume), *sœsœ perada* (*Globba* sp.), *sœsœ pœka* (*Fatoua pilosa* Gaudich.), and *sœsœ rimaœ* (*Polystictus sacer* Fries). In the second case, for plants mostly with milky sap, we find *geteh sœsœ, djintahan sœsœ, gelang sœsœ and gitan sœsœ* (*Willughbeia firma* Blume), *kolonsœsœ* (*Calotropis gigantea* R. Br.), *kalansœsœan* (*Plumeria acuminata* Ait.), *balam sœsœ* (*Palaquium acuminatum* Burck), *kajœ sœsœ* (*Cerbera manghas* Linn.), *kambang sœsœ* (*Tabernœmontana divaricata* Linn.), *sirawan sœsœ* (*Arcangelisia flava* Merr.), and *madang sœsœ* (*Ficus alba* Blume.) Applied to plants without milky sap, but here in the sense of *sœsœ* = breast or nipple, as the same root *susu* is applied in the Philippines in such plant names as *susong kalabao, suso-susoyan, suso koyili, susong damulag,* and *susong kabayo,* we find in Malaysia *arenj sœsœ mœndeng* (*Elœagnus javanica* Blume), *pasang sœsœ* (*Quercus teysmannii*

[12] **Bakhuizen van den Brink, R. C.** Welke Planten vindt men op de Boroboedoer afgebeeld? Trop. Natuur, **20**: 181-186. *f. 1-6.* 1931.

[13] **Cammerloher, H.** Wat de Boroboedoer den natuuronderzoeker leert. Trop. Natuur, **20**: 141-152. *f. 1-14.* 1931. Die Pflanzendarstellungen auf den Reliefs des Borobudur (Mittel-Java). Nature, **14**: *222-229. f. 1-11.* 1933.

[14] **Bakhuizen van den Brink, R. C.** De Indische Flora en hare eerste Amerikaansche indringsters. Nat. Tijdschr. Nederl. Ind., **93**: 20-55. *t. 1-4.* 1933.

Blume), *djambœ sœsœ* (*Eugenia malaccensis* Linn., *Psidium guajava* Linn.), *bœwali sœsœ* (*Passiflora laurifolia* Linn.) and *sirikadja sœsœ* (*Annona muricata* Linn.). Variants as single words are *sœsœan, sœsœdœ, sœsœk, sœsœn, sœsœkan,* and *sœsœrœ,* and *sœsong.* No better success is met in an attempt to locate *gelœng, gœlœng,* and *golong,* and the supposed derivatives of these words *culong* (*kulong*) and *culu* (*kulu*), as parts of plant names in Heyne's long list. In view of this evidence I am unable to accept Bakhuizen van den Brink's suggested origin of *gulong tsjutsju, culong tsjutsju* and *culu tsjutsju* as corruptions of pure Malay words [p. 304(127)], but rather considered that they are merely corruptions of the Mexican-Philippine *kalachuche.*

The frangipanni, temple flower, or graveyard flower, *Plumeria acutifolia* Ait., is now universally distributed in cultivation in the tropics of both hemispheres. It is indubitably a native of Mexico. What light does comparative philology throw on its introduction into the Old World?

In Java the tree is known by various local names including *kambodja, sambodja, sembodja, tjampaka bakul, tjam-*[129]*paka maldja, tjampaka sabakul, tjompaka bakul, tjompaka maldja,* and *tjompaka sabakul. Kambodja* as a plant name was derived from Cambodia, a place name, the latter derived from Kambu, mythical founder of the Khmer race; it is certainly Sanskritic in origin. It seems to be evident that it was applied to the *Plumeria* in various parts of Malaysia under the impression that the plant came from Cambodia; and indeed it may well have been introduced into some parts of Malaysia from that country although it is not native there, nor is there any evidence of its ancient cultivation in Cambodia; the only recorded names I have been able to locate for Indo-China are *co koc don, cay dai,* and *tiampa* (the latter a variant of *champaka*). In the Philippines we find a parallel in the application of the names *akapulko* and *kapurko* to *Cassia alata* Linn., the name derived from the Mexican city of Acapulco whence the plant was introduced into the Philippines. Similarly, such Philippine plant names as *kauayan sina, bunga china,* and *kapas sanglai* (from China, or of the Chinese) indicate the belief, not always true, that the plants to which they appertain came from China. Such names are common in Malaysia, Heyne listing perhaps one hundred. Thus for plants *of strictly American origin* we find *manila* and *katjang manila* (*Arachis hypogœa* Linn.), *sawo manila* (*Achras zapota* Linn.), *nangka manila* (*Annona muricata* Linn.), *ki manila* (*Cassia alata* Linn.); *kalœ djawa* (*djawa* = Java), *œnti djawa, mœrœ djawa* (*Carica papaya* Linn.), *œbi djawa, lame djawa* (*Ipomœa batatas* Poir.), *panda djawa* (*Ananas comosa* Merr.), *pandang djawa* (*Agave cantala* Roxb.), *katabi djawa, sabrang djawa, kentang djawa* (*Solanum tuberosum* Linn.), *srikaja djawa* (*Annona muricata* Linn.), *terœ djawa* (*Zea mays* Linn.), *kœnjit djawa* (*Bixa orellana* Linn.); *ketepang tjina* (*Cassia alata* Linn.), *lehiœ tjina, njiha tjina* (*Arachis hypogœa* Linn.), *œbi tjina* (*Ipomœa batatas* Poir.), *medjawik tjina* (*Maranta arundinacea* Linn.), and *petenj tjina* (*Leucœna glauca* Benth.). Not one of these names indicates the true geo-[130]graphic origin of the plant concerned. Other geographic names used as parts of plant names include *malaka* (Malacca), *timor* (Timor), *bali* (Bali), *bandœng* (Bandong), *ambon* (Amboina), etc., as well as the words *kastela, kastila, kastera, katila,* and *hale kastila* (Cas-

tile), indicating some connection or assumed connection with the Spaniards.

It seems entirely safe to conclude that the application of the name *kambodja* to *Plumeria* in Malaysia only indicates a plant of exotic origin that was merely thought to have come from Cambodia, but not necessarily one of ancient introduction. It is interesting in this connection to note that slight variants of this word are used for other introduced species wholly unrelated to *Plumeria,* such as *kambodjo, karambodja,* and *karambodjo* (*Citrullus vulgaris* Schrad.), and *kampadja* (*Carica papaya* Linn.).

The *tjampaka* series, in my opinion, merely represent borrowed names adopted, with modifiers, from the Sanskritic *champaka,* as was the case in India [p. 307 (133)]. There is no evidence that *kambodja* was ever used by Sanskritic peoples as a plant name.

In the Philippines where the *Plumeria* was introduced from Mexico by the Spaniards in the sixteenth or early in the seventeenth century, it is very widely known as *kalachuche;* some of the Philippine variants are *kalachuchi, kalasusi, kalasutsi, kalanoche, karachucha, kalasasi, kalatsutsi,* and *karatuche.* These are all slightly modified forms of the ancient Nahautl name *kalachuchl,* in Mexico. The name was introduced into the Philippines by the Spaniards with the plant itself. Among the forms used in Mexico today are such variants as *cacaloxochitl, cacalosuchil, cacalojoche, jacalosuchil, suchlacahue,* and *tizaxochitl,* all cognate forms of its Nahautl name, even as the lesser variants in the Philippines were derived from the same source.

Mercado,[15] writing in the last third of the seventeenth century, categorically states under *calachuche* "Aunque [131] este árbol no es de esta tierra, sino traido de la Nueva España, hay ya tanto aqui que no hay pueblo donde no le haya." This was perhaps written not more than a hundred years after the plant was introduced into the Philippines and by an individual born in the Philippines in 1640 and who doubtless was familiar with the plant from his early youth. The Spaniards commenced active colonization of the Philippines, operating from Mexico, in 1565. Camell[16] slightly later merely describes it as *Cacaloxochitl Mexicana,* but does not definitely state that it was Philippine although we may infer that this was the case, otherwise he hardly would have described it in a work on Philippine trees. Rumphius[17] states regarding this plant as it occurred in Amboina: "Videtur primum ex Cambodja fuisse deductus, unde & nomen obtinuit, ac forte primum in Ternatam per Sinenses mercatores, unde ante paucos quosdam annos in Amboinam delatus est, in Java tamen aliisque locis itidem obcurrit. Alii dicunt in Manilhis quoque reperiri, atque inde cum subsequenti flore [Flos manilhanus = *Tabernaemontana divaricata* R. Br.] in Ternatam fuisse deductum." This is a most significant statement. It should be remembered that the Spaniards captured Ternate and Tidore in 1609 and

[15] **Mercado, I.** Libro de medicinas de esta tierra y declaraciones de las virtudes de los árboles y plantas que están en estas Islas Filipinas. Blanco, M. Fl. Filip., ed. 3, 4 (2): i-vi. 1-63. 1880.

[16] **Camell, G. J.** Descriptiones fruticum & arborum Luzonis. *In* Ray, J. Hist. Pl., 3: App. 79. 1704. (This manuscript was sent to Petiver in 1701 and was probably written in the last decade of the seventeenth century.)

[17] **Rumphius, G. E.** Herbarium Amboinense, 4: 86. *t. 38.* 1743. (The manuscript must have been written before 1670, the date when Rumphius became blind; final copy of this part of it was made in 1695.)

maintained control of these islands over fifty years, operating from Manila. Compare also Rumphius' statement that the plant was then (about 1670) a recent introduction into Amboina with Mercado's statement that in the last half of this same century there was scarcely a town in the Philippines where the plant did not occur.

Heyne records about forty different names used in Malaysia for this species, many of them in the *kambodja* and *tjempaka* series, and all or mostly borrowed ones. It is significant that in Celebes, Ternate, and in Ceram, islands [132] to the south of the Philippines (and Ternate and Tidore were actually occupied by Spain following 1609) we find such names as the following in actual use today: *karasœsi, kolotjœtjœ, kalasœsœ, kalansœsœn, kalongsœsœ,* and *saja kolotjœtjœ.* These are apparently all derived from the Mexican-Philippine *kalachuche,* the name transmitted southward from the Philippines with the plant itself. One can scarcely credit Bakhuizen van den Brink's belief [see p. 304 (127)], in view of this evidence, that the cognate forms *gulong tsjutsju, kulutsjutsju* and *kulongtsjutsju* mentioned by him are of pure Malay origin.

It is improbable that the Portuguese introduced this plant into India direct, first for the reason that they had no Mexican contacts, and second because Rheede tot Draakestein does not describe it in his monumental work on the plants of Malabar (1678–1703). Had the species been of twelfth century, or earlier, introduction into any part of tropical Asia, it is certain that it would have been generally disseminated in India shortly after such introduction. Surely if it occurred in Cambodia or in Java at that time, it certainly would also have been introduced into India and into Amboina, yet we have Rumphius' statement that it was only introduced into Amboina shortly before 1670. The fact that Rheede tot Draakestein did not illustrate and describe it is distinctly conclusive evidence against the occurrence of *Plumeria* in India until after its introduction by the Europeans sometime after 1700. On the whole it seems to be highly probable that it reached India from the Philippines, having been transported by some returning traveller or merchant.

Such Indian names as *gulachin, gutachin,* and *golainchi* are suspiciously like its modified Nahautl *kalachuche* as used in the Philippines, and I suspect are but corruptions of it. This then would be merely another case of a plant introduced into a new region with its original name somewhat modified. The longer series of names used for this plant in India exactly parallel the Javan series derived [133] from *champaka,* and include such forms as *china champac, gorur champa, catchampa, champa pungar, khair champa, dolochampa, dolochapa, goburchamp, khad-champo, rhuruachapa,* and *rhadachampo.* The "champa" and cognate forms of this part of the names is from the vernacular *champa* or *chambac* (Sanskritic *champaka*), properly the name of the magnoliaceous *Michelia champaca* Linn. In India and in Java, this local name, with modifiers, was apparently applied to the introduced frangipanni because of one similar character common to the two totally different plants, the very fragrant flowers. The names used for this plant in most parts of the Old World, other than the corruptions of its Nahautl *kalachuche,* are merely borrowed ones, undoubtedly indicating an introduced plant for which it was desirable to coin a new name. The evi-

dence from early European accounts, early European trans-Pacific contacts, and that of its local names in the Old World, to me point unequivocally to the introduction of this plant into the Orient by the Spaniards via the old Acapulco-Manila trade route, sometime after 1565, and its dissemination into other parts of the Old World tropics from the Philippines.

My response to Bakhuizen van den Brink's positive identification of the crude twelfth century Borobudur relief as representing *kambodja* = *Plumeria acuminata* Ait. is that this greatly conventionalized figure does not represent a *Plumeria*, no other tangible evidence existing that this plant occurred in Java before it was introduced by the Europeans not earlier than the seventeenth century, and that the figure may in all probability be merely a crude and greatly conventionalized attempt to depict *Tabernæmontana divaricata* (Linn.) R. Br., a species which probably was cultivated in Java when the Borobudur temple was constructed, or even a more crude representation of the very common *Murraya paniculata* Jack. As I see the picture the botanical, historical, and philological evidence is wholly opposed to the introduction of *Plumeria* into the Old [134] World before the latter part of the sixteenth or the early part of the seventeenth century.

Hibiscus tiliaceus Linn.

Conclusions drawn from partial evidence are frequently untrustworthy. As an illustration of this point the case of *Hibiscus tiliaceus* Linn. is illuminating. In 1918 O. F. and R. C. Cook[18] extensively discussed this species making the remarkable statement: "as with the coconut palm and the sweet potato the *maho* figures more prominently among the Polynesians than among the natives of tropical America, *although the American origin of the plant is even more clearly indicated*" (italics mine). They erroneously assumed that it was a cultivated plant in the Old World and a wild one in America. As a matter of fact it occurs naturally along the strand throughout the tropics of both hemispheres and unquestionably attained its world-wide distribution some millions of years before man became a factor in plant distribution. Its seeds are ideally adapted to dissemination by floating in salt water, as the hard seed coat is impervious and the seeds float indefinitely. Guppy[19] includes it in the list of those littoral plants whose seeds "float for months." I know of no records that indicate just how long they will float and still retain their viability. In some regions it occurs in dense thickets inland, and in parts of Polynesia it was formerly planted. Its relative prominence as an economic plant in Polynesia was due to the fact that in many islands it was the only or chief source of fibres for nets and cordage.

The basis of Cook's argument was apparently the similarity between its vernacular names *maho* and *mahagua* in tropical America, and its Polynesian names in the *hao, mao, mau, vao* series. They erroneously assumed that it was a wild plant in tropical America and a cultivated one in the [135] Old World. They were intrigued to find support to a general thesis of an early westward migration of peoples and cultures into Polynesia from

[18] **Cook, O. F., and R. C.** The Maho or Mahagua as a Trans-Pacific Plant. Jour. Washington Acad. Sci., 8: 153-170. 1918.

[19] **Guppy, H. B.** Observations of a Naturalist in the Pacific between 1896 and 1899. Seed Dispersal, 2: 552. 1906.

tropical America. As with O. F. Cook's earlier argument based on the origin and dispersal of the coconut, his contentions and conclusions fail to convince the investigator who considers both sides of the argument, and can only be classed as a failure whether judged by the points that were assumed to support the theory, or by those data opposed to it that were not cited.

What is the contribution to the problem from comparative philology? We admit at the outset a similarity between the American and the Polynesian names, but is this similarity more than accidental? What do we find as between the Indo-Malaysian and Polynesian names? It was assumed by Dr. Cook that the similarities between the American and the Polynesian names *were conclusive*, but that certain names used in Fiji, Guam, and the Philippines might not belong in the *maho* series. I believe both assumptions to be wrong. The numerous Malaysian names were largely ignored but it was admitted that those used in Madagascar and in neighboring islands appeared to be connected with the Malaysian and Polynesian series.

The significant recorded Philippine names for this plant are *bago, balibago, balobago, malabago, malabagu, malambago, mayambago, mulabago.* Of these *malabago* and *balibago* are the most commonly used ones. Significant names in Malaysia are *balebirang, balœh, balo, baœ, bœok, bagœ, bahœ, barœ, barœ bhender, barœch, boœ, faœ, halœ, haœi ai, harœ, kabarœ, kalimbaœan, kawaœan, kelambœoen, lago, lamagœ, molombahœ, molumbagœ, molowahœ, molowagœ, baœk, sirœn, wahœ, waœ, warœ, warœ laœt, warœ lenga,* and *warœ lengis;* in Madagascar and neighboring islands *baro, var, varo, vau, vaur;* and in India *bania, baria, bola.* In various parts of Micronesia and Polynesia, we find the following: *hau* (Hawaii), *au* (Rarotonga), *fau, burau, au* (Makatea), *fou fafine* (Funafuti), *fau, fau to* (Samoa), *purau fau* (Tahiti), *vau, vau dina* (Fiji), *karao* (Ponape), *fau* [136] (Rapa), *hau, fau* (Marquesas), *purau* (Tuamotus), and *pago* (Guam).

The only conclusion that I can draw is that the whole series of Indian, Mascarene, Malaysian, Philippine, Micronesian, and Polynesian names for this ubiquitous pantropic strand tree are cognate forms of one word. I suspect that the root of this word perhaps originally appertained to bast fibres, or to a plant that produced strong bast fibres, and that its application was gradually extended not so much to those species that resembled the original, but to unrelated forms that produced bast fibres. In support of this contention *bago* is a Philippine name very widely applied to *Gnetum gnemon* Linn., a plant that produces one of the strongest bast fibres; *malabago* as applied to *Hibiscus tiliaceus* Linn. is literally "false bago." In various parts of Malaysia *Gnetum gnemon* Linn. is known under such names as *ai howa, ai sowa, ambong bagœ, bagœ, bakœ-bakœ, bangœ,* and *blinago, wahœ, wagœ, wa sowa, œwali, wali, ta amœ, sœwa, loi,* with numerous other local names unrelated to this series.

Again in the Philippines we find the same root in widely used words for certain thymeleaceous representatives of *Wickstrœmia* and *Phaleria* that have strong bast fibres but which otherwise do not in the slightest resemble *Gnetum gnemon* Linn., or *Hibiscus tiliaceus* Linn.; such names include *bago, bari, salago, baleo,* and *palupo.* In Polynesia we find *Wickstrœmia*

known as *o'ovau, oaao* and *oaao-ao* in Tahiti, *auo-era* in the Marquesas Islands, and a *Phaleria* known in Samoa as *suni vao*. In other parts of Polynesia quite different names are used, such as *akia, akai, akia kaule, tao wap* (the first part of which I suppose may be assigned to the *vao* series) and in Palau as *ongœl*. And it is perhaps significant that in India certain names of *Daphne*, another thymeleaceous plant with strong bast fibres, are *set buruwa, satpura, shedbarwa, balwa, bhalua,* and *barua*. Is not our common American name for *Tilia*, bass wood = bast wood, a parallel case? I believe that the recurrence [137] of this form to represent plants wholly dissimilar, except in producing strong bast fibres, is supporting evidence for the contention that the original word appertained essentially to bast fibres and became applied to various plants that produced strong bast fibres.

As *Hibiscus tiliaceus* is essentially a plant of natural distribution, as opposed to one distributed primarily by man, the only logical conclusion that one can draw from the evidence of comparative philology is that the name, often more or less modified, was carried from west to east by an early migrating or expanding people of Indonesian stock and applied to the plant found growing naturally in all or most lands that these people reached. These migrating peoples in many cases found in their new homes no better fibre material than that yielded by this *Hibiscus*, and continued to call the plant by the name with which they were familiar in the lands whence they came. Forms of the same name were also applied to *Gnetum, Daphne,* and *Wickstrœmia*, not because these resembled each other but merely because they produced strong bast fibres.

In the Philippines the g is the same as the r of the RGH law[20] which is as well established for these languages as is Grimm's law for the Indo-European ones. This law applies to certain consonants in Malaysian and Philippine languages, in initial, medial, and final positions where with a reasonable degree of regularity one consonant is substituted for another, and at times certain ones are eliminated. Indonesian linguistics postulate the existence in the archaic mother language of a sound which was pronounced in various ways and which accordingly now appears in different dialects in various forms. These are R, G, H, Y, and L. This is illustrated by the Indonesian word for vein or root, appearing in different dialects as *urat, ugat, uhat, uyat, ulat, uwat* and *uat*. This chameleon of sound appears to be present in the word *bago* and nobody should be surprised [138] to find it recurring in such forms as *baro, baho, bayo, balo, bawa, bao,* etc.

From a purely philological standpoint a very weak spot in Cook's argument is the expressed doubt that the Fijian *vahu* (it should be *vau* fide Mr. Sydney Ray), the Philippine *balibago*, and the Guam *pago* belong to the *mao* series. The elimination of the consonant in the Polynesian forms is exactly what we might expect to find if the theories of comparative philologists be reasonably correct, and I see no reason for doubting the validity of their conclusions. One does not have to be an accomplished comparative philologist to realize that the Malaysian and Polynesian languages are closely allied, perhaps the most noticeable differences being in the elimination of certain consonants in Polynesian speech.

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[20] **Conant, C. E.** The RGH Law in Philippine Languages. Jour. Am. Oriental Soc., **31**: 70-85. 1910.

Sanskritic Plant Names in Malaysia and the Philippines

A considerable number of plants are today commonly known in Malaysia, including the Philippines, by but slightly modified Sanskritic names. In view of the fact that the Malaysian languages have no general relationships with ancient Sanskrit, what is the significance of these names? Most of the plants to which they are applied are exotic, as far as the archipelago is concerned, but at least two species are indigenous. Among these plant names that I consider must be interpreted as of Sanskritic origin are the following:

Sulasi (Sansk. *tulasi*) a name widely applied to several species of *Ocimum* in the Philippines and in Malaysia. *Lasona* (Sansk. *lasuma, rasona*) in the Philippines applied to the common onion (*Allium cepa* Linn.), with many cognate forms in Malaysia.. *Malisa* (Sansk. *maricha*) applied to the black pepper (*Piper nigrum* Linn.) in the Philippines, with numerous cognate forms in Malaysia. *Kachumba* and *kasobha* (Sansk. *kasumbha*) names of the safflower (*Carthamus tinctorius* Linn.) used in the Philippines with [139] cognate forms in Malaysia for this introduced and cultivated plant. *Malunggai* (Sansk. *marungi*) the common Philippine name for the horse-radish tree (*Moringa oleifera* Lam.) with cognate forms in Malaysia. *Kasturi* (Sansk. *latakasturika*) a Philippine name for *Abelmoschus moschatus* Medic. (*Hibiscus abelmoschus* Linn.), with cognate forms in Malaysia. *Mutha* (Sansk. *mustaka,* Hindu *mutha*) used in the Philippines for a ubiquitous weedy sedge (*Cyperus rotundus* Linn.), with *mota* in use in Java and *wœta* in Celebes. *Patola* (Sansk. *patola*) is the Philippine and Malaysian name for two species of the dishcloth gourd (*Luffa*); the Sanskritic name belongs with *Trichosanthes,* another genus of the same family. *Champaka* (Sansk. *champaka*) is a common Philippine and Malaysian name for the introduced and cultivated *Michelia champaca* Linn. *Dansuli* (Sansk. *gandasuli*) is used in Mindanao for the introduced *Hedychium coronarium* Koenig, with cognate forms in Malaysia. *Lagundi* (Sansk. *nirgundi*) in various forms is commonly applied in the Philippines and in Malaysia to both *Vitex negundo* Linn. and *V. trifolia* Linn. *Daua* (Sansk. *yava* = barley, or perhaps originally "cereal") is the usual name in the Philippines for the cultivated Italian millet (*Setaria italica* Beauv.) with cognate forms in Malaysia; in Malaysia it is also applied to other cultivated cereals such as *Andropogon sorghum* Brot., and in Sumatra to *Eleusine coracana* Gaertn. as *djaba.* This root is apparently the source of the place name Java, indicating a rich agricultural island. The list of Sanskritic plant names in Malaysia could be considerably extended.

As these species occur in the Philippines and in Malaysia, at least six are normally found only in cultivation, the onion, black pepper, safflower, patola (as to the cultivated forms, but forms of *Luffa cylindrica* M. Roem., commonly occur as wild plants), champaka and Italian millet. The *Moringa* is semicultivated, rarely, perhaps never, truly wild. The *Hedychium* is both cultivated and naturalized. Various forms of *Ocimum* are planted and also occur as [140] casuals in and about towns and settlements. The *Cyperus* and the two species of *Vitex* are true natives, or possibly one, *Vitex negundo* Linn. is an introduced plant. The *Abelmoschus* is everywhere naturalized, but is manifestly an introduced plant. We are thus, for the

most part, dealing with a series of introduced plants, several of which are entirely dependent on man for their continued existence in the Archipelago.

The most logical explanation of the occurrence of these plant names in the Archipelago is that these exotic species were introduced from India with their original Sanskritic names at the time of extensive contacts between India and Malaysia. It is definitely known that advanced Indian peoples visited the Malay Archipelago in the fourth and fifth centuries B.C. Later they colonized the region, this colonial venture eventually culminating in the establishment of the empire of Sri-Vishaya or Sri-Vijaya in Sumatra, dominant from the seventh to the twelfth century. This Sumatran empire, at the peak of its power, embraced much of the Malay Archipelago, except parts of Java, the Lesser Sunda Islands, and New Guinea. It colonized or controlled the Philippines and had outposts in Formosa and in Hainan, even collecting tribute from Ceylon and from southern India.

This Sumatran state was gradually undermined and finally superseded in the twelfth century by the growing Javan state widely known as the Empire of Madjapahit. This Empire dominated the entire Malay Archipelago, including the Philippines, and even extended its influence to New Guinea. Its power was broken by the introduction of the Mohammedan religion and its rapid spread in the fifteenth century.[21] It was during the period of dominance of this old Javan state or empire that the great temple at Borobudur was constructed, this dating from the twelfth century.

[141] We thus have a logical explanation of the occurrence of borrowed Sanskritic names among an alien people. There is no reason to suppose that these plants, so far as they are introduced ones in Malaysia, were introduced from India with their Sanskritic names by the Malay peoples. Rather it seems logical to explain them by assuming that the expanding and colonizing peoples of India, extending their sway to the Malay Archipelago, took with them their own cultivated plants, thus introducing their own names with the plants themselves; and the names have persisted throughout the centuries that have elapsed since these old empires were destroyed, although practically all knowledge of the ancient domination of the Archipelago by alien Indian peoples has been lost to the present-day natives of Malaysia. To a certain degree, we are able to reconstruct the picture of colonization, conquest, and control of a vast archipelago by an alien people, although the extant historical data are scanty. Combining what is known of the history of the region from 500 B.C. to about 1500 A.D. with certain botanical and philological data, we can, I believe, assume that these early Indian colonizing peoples did just what our own ancestors did when they colonized the eastern part of North America; they naturally brought with them their own culture, and to support this culture in the new environment they brought with them the cultivated plants and domesticated animals on which they were dependent for food in their old home. Where in Malaysia they found growing plants identical with those they knew in India, they naturally applied their own names to these plants, and these names, such as those for *Vitex* and *Cyperus,* exceptionally were adopted for these plants by the alien peoples that the invaders controlled. In some cases the invaders

[21] **Beyer, H. O.** The Philippines before Magellan. I. The Hindus in Malaysia. Asia, **21**: 861-866. 1921.

undoubtedly adopted Malaysian plant names, but this would probably be confined to those cases where species were represented with which they were not familiar in India. We here have an excellent example of diffusion, not only of the civilizing influences of the advanced Indian peo-[142]ples, who in expanding colonized not only Indochina but the Malay Archipelago as well, but who in their colonial expansion also took with them the cultivated plants with which they were familiar at home.

Chinese Plant Names in the Philippines

Like the Indian peoples the Chinese have had long continued contacts with the Philippines, undoubtedly exceeding 2000 years. While a considerable number of Chinese words have been incorporated in the Philippine languages, the number of plant names is relatively few; and they are all names of plants that occur only in cultivation, although one species (*Dolichos*) is naturalized in certain regions. This paucity of Chinese plant names is probably explainable by the fact that most of the Chinese visiting the islands have been traders rather than colonists.

Plant names of Chinese origin, all applied to cultivated plants of exotic origin, are as follows: *tunghao* (*Chrysanthemum coronarium* Linn.), *ungsoi* (*Apium graveolens* Linn.), *batau* (*Dolichos lablab* Linn.), *sitau* (*Vigna sinensis* Savi), *pechai* (*Brassica pekinensis* Rupr.), and *kuchai* (*Allium uliginosum* G. Don). The Chinese word *cha* = tea, is locally applied to *Ehretia microphylla* Lam., sometimes used as a substitute for tea, and in such compounds as *chaang-bundok,* and *chaang-gubat,* literally wild tea. The occurrence of these Chinese names in the Philippine languages to a certain degree parallels the Sanskritic names discussed above, clearly indicating certain early contacts and, of course, a certain diffusion of useful plants and their names. Some of these plants, such as *Dolichos lablab* Linn., may have been introduced into the Archipelago by other than the Chinese, but most of the plants mentioned are peculiarly characteristic of Chinese agriculture.

Mexican Plant Names in the Philippines

The Philippine Archipelago was discovered by Magellan in 1521. About forty-three years later the Spaniards com-[143]menced active colonization from Mexico as a base. The first settlement was made at Cebu in 1564, but six years later Manila was selected as the center of operations. To maintain contacts the Manila galleon route was established, the ships being dispatched annually from the west coast of Mexico, first from Navidad and later from Acapulco, to Manila, and vice versa. For about 250 years this trade route was maintained, being terminated by Mexican independence about 1820. This broke the lines of communication between Spain and the Philippines via Acapulco, Mexico City, and Veru Cruz, after which the islands were opened to foreign trade. For much of the preceding 250 years the trans-Pacific Philippine-Mexican trade had been largely in the nature of a government monopoly. As throughout this entire period the Philippines were governed more or less as a dependency of New Spain, we should naturally expect to find certain Mexican influences in the Philippines.

In plant names of introduced species we find a beautiful parallel in the

Philippines as between the somewhat shadowy Asiatic contacts through Malaysia up to the close of the fifteenth century, and the more sharply defined Mexican contacts after the Acapulco-Manila galleon route was established. Naturally the colonizing Spaniards introduced a large number of Mexican species into the Philippines, and the Archipelago thus, to a certain degree, became a center in the Old World for the dissemination of American plants, both economic species that were purposely and weeds that were accidentally introduced. Essentially the process was the same as that which I have assumed to be the case in pre-Spanish times when the Islands were controlled and colonized by Indian peoples.

Most of the plant names that the Spaniards introduced from Mexico with the plants were naturally of Mexican and chiefly Nahautl origin. Among them are *kolites,* applied to certain edible species of *Amaranthus,* but here the name was probably merely applied to the plants in the Philip-[144]pines; this does not predicate the actual introduction of *Amaranthus* from Mexico, although some forms may have thus been introduced. *Abutra* is a somewhat similar case. This name is applied to an *Arcangelisia* in the Philippines, but the word is of American origin, appertaining to the genus *Abuta* of tropical America. In the Philippines the name was applied by the Spaniards to a native species that was supposed to have the same medicinal properties as its American congener; it has several native names of Malaysian origin, such as *lagtang, suma* and *uplig.* More closely associated with introduced plants of indubitably American and chiefly of Mexican origin may be mentioned the following: *kakauate* (*Gliricidia sepium* (Jacq.) Steud.); *kalachuchi* (*Plumeria acuminata* Ait.); *kamanchile* (*Pithecellobium dulce* (Roxb.) Benth.); *kamote,* the sweet potato (*Ipomœa batatas* Poir.); *chiko* (*Achras zapota* Linn.); *chiko-mamei* (*Calocarpum sapota* (Jacq.) Merr.); *sapote* (*Diospyros ebenaster* Retz.); *aposotis* (*Chenopodium ambrosioides* Linn.); *kamate* or *tomate,* the tomato (*Lycopersicum esculentum* Linn.); *cacao* or *chocolate* (*Theobroma cacao* Linn.); *ayapana* (*Eupatorium triplinerve* Vahl); *mani,* the peanut (*Arachis hypogœa* Linn.); *mana* (*Jatropha multifida* Linn.); and *maguey* (*Agave cantala* Roxb.). *Akapulko* or *kapurko* (*Cassia alata* Linn.) probably indicates the place of origin, Acapulco, as far as the Philippine occurrence of this species is concerned, quite as *sawo manila* and other similar names [see p. 305 (129)] in Java indicates the place whence *Achras zapota* was at an early date introduced into that island, and as the Manila tamarind, in the eighteenth century became a somewhat accepted name in India for *Pithecellobium dulce* Benth., which was introduced into India from the Philippines by the captors of Manila in 1762.

In some cases names introduced from Mexico with the plants have undergone great modifications in the past two or three hundred years, as illustrated by the word *kamanchile* (*Pithecellobium dulce* Benth.). While this form is [145] even now the most generally used one in the Philippines, it has varied from the original to such an extreme as *damortis,* the series running *kamanchile, kamansile, kamarsilis, kamunsil, kamontres,* etc., to *chamultis, damulkis,* and *damortis.* In this series of Philippine names fifteen variants are now recorded. As such a sharply differentiated and easily pronounced word as *kamanchile* has run this gamut of change in less than 300

years, among a people for most of this period predominantly illiterate, it is perhaps understandable how we may expect other words and other plant names to vary to confound the comparative philologist. The species in question is a very sharply defined one, with no near allies in the Philippines, and is a tree of very considerable economic importance, partly because of its edible fruit, but chiefly because it yields the most used tan bark in the Archipelago.

Most of the introduced plant names have varied but slightly or not at all. With such variations as these indicated above from *kamachile* to *chamultis, damulkis,* and *damortis* in 300 years or less, we can more readily appreciate the reasons for variations in the series of names for the coconut and for *Hibiscus tiliaceus,* discussed above, and those for very numerous other cultivated and wild species in Indo-Malaysia, for with these some thousands of years are involved. And we should remember that in the Malay Archipelago and the Philippines about 400 languages or dialects are spoken.

As the Sanskritic and Chinese plant names in Malaysia indicate early contacts and a certain diffusion, so also do the names of American origin indicate contacts and diffusion, but the latter was strictly within the historical period of the last 350 years or so. Attention has been repeatedly called to the fact, for the benefit of the extreme diffusionists in anthropology, that no important cultivated food plant or domesticated animal, other than the dog, in pre-Columbian times transcended the limits of the eastern or the western hemisphere. As the Eurasian civilizations were based on [146] an agriculture founded on strictly Eurasian plants and animals, and as the pre-Columbian American civilizations were based on a strictly American agriculture in turn based on native American plants and animals, it seems to be evident that the Atlantic and the Pacific Oceans formed practically impassable barriers to early and late civilized man up to the close of the fifteenth century. Had there been contacts by which the civilizations of one hemisphere influenced those of the other, it is inevitable that contacting peoples would have transmitted from one hemisphere to the other some of the plants and perhaps some of the animals on which their civilizations were based and by which they were maintained. There is thus a limit to diffusion that the extreme diffusionists have not recognized, and this limit is a geographical one, in general the boundaries of the eastern and of the western hemispheres. Most of the basic cultivated food plants were widely distributed within the limits of one hemisphere or the other long in advance of the spread of the advanced cultures developed in favored localities in Eurasia and in America; in other words the diffusion of culture failed to keep pace with the diffusion of agriculture, and in the extension or diffusion of both agriculture and the cultures based upon it there were definite geographic limits that were not transcended until the close of the fifteenth century.

— XV —

DOMESTICATED PLANTS IN RELATION TO THE DIFFUSION OF CULTURE*

ATLANTIS AND THE LAND OF MU

[1] When Europeans first came in contact with the primitive and advanced civilizations of North and South America at the close of the fifteenth century, it was perhaps but natural that they should attempt to explain what they found here, in the form of advanced cultures, on the basis of man's achievements in the Old World. Not far removed from the scholasticism of the Middle Ages, the writings of classical authors were naturally invoked to find support for the idea of trans-Atlantic contacts at a much earlier date than 1492. Many apparently thought that the high civilizations found in Mexico, Yucatan, Central America, Bolivia and Peru could be explained only on the assumption of ancient contacts between the peoples of the Old and the New World, involving architecture, sculpture, and various customs and practices, as well as civil, political and ecclesiastical organization; and apparently many still think so.

Those who turned to the classics found their explanation in Plato's account of Atlantis, the beginning of the Atlantis cult that will not down and the precursor of the extreme wing among modern diffusionists who predicate a single source of origin and a universal dissemination of culture.

Yet before the close of the seventeenth century serious doubts arose regarding the authenticity of the Atlantis account and any possible bearing that the Atlantis theory might have had on the development of culture in the New World. In 1670 Ogilby (26) voiced these objections, and his logical conclusions are thoroughly [2] in accord with the ideas of modern conservative ethnologists, but utterly opposed to the views of the extreme diffusionists. He states:

"Here it will not seem amiss . . . . to engage and search with some scrutiny concerning this America; First, whether at any time 'twas known by the Ancients? And next, by what People, and when first Inhabited? About the former, the Learned of these later times Jangle amongst themselves, for some of them will needs ascribe so much Honor to Antiquity, declining the Worthy Praise of those that made so wonderful a Discovery, as if they of old, and many Ages before, had done the same, or at least, that this New-World to them was not unknown, maintaining this their bold Assertion from the Authority of what they find, both in Ancient *Greek*, and *Latin* Authors; First, especially in the Learned *Plato,* who, as you know at large, describes a *New Atlantis,* lying beyond the Straights of Gibraltar; whose Coast is surrounded with two vast Seas that are sow'd thick with scatter'd Islands. By these Seas they understand the Atlantick and Southern Sea, by the many Isles, *Cuba, Hispaniola, Jamaica, California,*

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and others, which lie sprinkled along the coast of *America*. But it cannot be made out, that *Plato* describes ought but a Fancy, his own Idea, not a Countrey that ever was, is, or shall be, though he sets it forth so Accurately, and with such Judgment, as if he had taken a Survey of the place, and found such a Land Indeed."

But the Atlantis explanation of similarities and assumed similarities between Eurasian and American cultures was not the only one, for before 1670 the peoples of ancient Greece, Italy, Carthage, Phoenicia, Palestine, Wales and China had been invoked to explain this enigma, and by that time or somewhat later the Irish, Egyptians, Japanese and others were involved. The idea persisted and still persists, that somehow, sometime, there must have been contacts of advanced peoples across the Atlantic or the Pacific Oceans, or both, long antedating the voyage of Columbus.

Ogilby proceeds to discuss the various explanations that had been offered, other than the Atlantis theory that he had disposed of, and even on the basis of the comparatively little data that were then available concluded that these ancient contact theories were all untenable on the basis of philology, customs and other factors. His final conclusion was the generally accepted modern concept [3] that man reached America over a northern route from northeastern Asia.

If there were no limits to the diffusion of culture, and only one center of origin, then we might expect to find evidence that all culture reached America over that ancient northern route, but this is manifestly not so. It is believed that within the general field of biology there is available incontrovertible evidence which to a remarkable degree supports the contention that early man reached America over a northern route from Asia, bringing with him his primitive culture, but that the development of agriculture in America and the cultural advances that an established agriculture made possible in certain favored regions were autochthonous, not in the slightest degree influenced by Eurasian developments until after the last decade of the fifteenth century.

In spite of the fact that the biological and geological evidence is utterly opposed to the Atlantis theory (2, 16, 18, 33, 34, 35), it is surprising how firmly fixed this idea is in the public mind. It is an intriguing theory, a simple explanation of assumed similarities, and those who have sponsored and supported it have presented convincing arguments in an attractive manner. Although actual and assumed similarities as well as alleged and purely imaginary ones have been overstressed, opposing data ignored or misinterpreted, and, it is feared, the well-known statement of half truths invoked to support a preconceived theory, its ardent supporters scorn any refutation of the Atlantis idea. They may be reduced to arguing that "Atlantis has assumed too important a place in literary imagination ever to be destroyed by the dull findings of science"; "Atlantis is gone but it will be immortal"; and "We shall never permit Atlantis to be destroyed just to please geologists and botanists." Even if scientists are not convinced of the error of their ways by such arguments, it is to be hoped that they still retain a sense of humor that some of the ardent Atlantis supporters seem to lack.

In its extreme form the Atlantis theory assumes that Atlantis was popu-

lated by a highly civilized people and that from this source were derived the civilizations of the Mediterranean basin in Eurasia, and those of Mexico, Yucatan, Central America, Peru and Bolivia in America. To support a highly developed culture we must postulate a highly developed agriculture in ancient Atlantis. What could have been the basis of this agriculture that trans-[4]mitted to the supposed descendent colonies of Atlantis in Europe and in America not a single cultivated food plant or a single domesticated animal in common?

Although among scientists in general the Atlantis theory has long since been discarded as utterly untenable, it has been considered expedient to mention it briefly in the development of my theme. Fanciful as the Atlantis theory is, Churchward's (8) extraordinary and bizarre hypothesis of an ancient Mu in what is now the Pacific basin so far surpasses it in utter fantasy as to be unworthy of mention except as purely imaginary fiction. Had Atlantis or Mu, or both, existed, and had they been peopled by highly cultured peoples who reached the New as well as the Old World, and had there been marked anthropological, philological, agricultural (as to the species cultivated), and general cultural similarities between the early advanced civilized peoples of the two hemispheres, other than merely assumed ones, then there would be no need to consider this subject further, for there would have been a universal dissemination of a reasonably uniform agriculture, as to the species cultivated, and of the advanced cultures which are everywhere based on agriculture and by which they are maintained. We would not have had to wait until 1492 for the Europeans to discover America, for it would have been known to them for some thousands of years.

As noted above, the Atlantis cult was the precursor of the extreme diffusionist group among modern anthropologists. Briefly, as expounded by what may be called the Manchesterian school of this group under the leadership of Smith (28, 29, 30, 31) and Perry (27), all culture, including agriculture, originated in Egypt, and from this center, commencing in the ninth or eighth century B. C., this culture complex was diffused by migrations of culture-bearing peoples in all directions, after several hundred years ultimately reaching the Pacific coast of the Americas and leavening the aboriginal population of North and South America with the ferment of ancient civilizations of the Old World. It would be a curious migration that could transmit similarities of one type or another from Egypt to distant America across the Pacific Ocean, leaving no imprint on Egypt of any such records of expansion, colonization or conquest, for conquest it would have to have been, and no philological imprint on the diverse peoples of India, Malay-[5]sia, Melanesia, Polynesia, North, Central and South America, whom these hypothetical "heliolithic" peoples or the "children of the sun" contacted in their search for gold and pearls.

Not to be outdone by the ardent supporters of Atlantis, Mu, and the extreme diffusionists, witness the views of Cooper (14) who proves his thesis, at least as logically as do the supporters of Atlantis, Mu, and the extreme diffusionists their particular beliefs, that Salisbury Plain in England was the original center of all ancient culture, as characterized by H. L. Mencken (from Cooper's prospectus): "Massive and overwhelming proof

that the Garden of Eden was on Salisbury Plain. A masterpiece of archeological New Thought."

The biologist uninfected with New Thought can look on these curious contributions to the science of ethnology only as highly imaginative and sometimes entertaining fiction. The hypothetical highly cultured peoples of a hypothetical ancient Atlantis or an ancient Mu, the ancient "heliolithic" peoples of ancient Egypt, or the "children of the sun" of Perry, or even the ancient Druidical peoples of Cooper who centered about Salisbury Plain, all fall in one category. These imaginary peoples as expanding and civilizing groups who extended their influence literally "to the ends of the earth," to the biologist are merely figments of the imagination. If one is interested in bizarre, highly imaginary, dogmatic and uncritical data, largely based on preconceived theories, on false premises, and on abstractions of no evidential value, one will find these works at least entertaining, for there are apparently no limits to the idiosyncrasies of the human mind. But shall we accept, without question, such data as evidence of ancient intercourse between distant communities such as those of the Old and the New Worlds?

ORIGIN AND DIFFUSION OF CULTURE

I judge that it is entirely safe at the outset to predicate a more or less general diffusion of primitive culture. Skill in hunting and fishing, the use of clothing and of fire, the construction of shelters, the art of chipping stone to form implements, the dressing of skins, weaving and basketry, *i.e.*, all early arts, were apparently more or less universally disseminated in both hemispheres at a very early date, extending to the limits of the eastern and of the western hemispheres. Unless these primitive arts originated independently [6] in different centers, this was diffusion, and if one wishes to use the expression, universal diffusion. But is universal diffusion characteristic of all great advances in civilization? From the biological and agricultural evidence I can deduce only a negative answer. There is a very definite limit to the diffusion of agriculture on which the higher cultures were and are everywhere based, as well as to the diffusion of higher cultures themselves, and these limits are definitely the boundaries of the eastern and the western hemispheres.

The extreme diffusionists, like the ardent supporters of the Atlantis theory, see similarities between the pyramids of ancient Mexico and those of ancient Egypt; between this form of early architecture and that; between the sculpture and other artifacts of this people and that; and similarities in weaving, in basketry, in ornamentation, in terrace agriculture, irrigation, mummification, tattooing, and even in political, civil and ecclesiastical organizations, as between the peoples of the New and the Old Worlds. Having keen minds for similarities they see resemblances rather than differences, and explain the resemblances or fancied resemblances, such as G. Elliot Smith's (29) famous elephant trunks, on the basis of ancient contacts, overlooking or understressing the differences, for differences as exist between the hieroglyphics of Egypt and those of Yucatan are not explainable by any contact theory; they merely represent independent attempts to record the spoken word. After all, primitive architecture, sculpture, weaving, basketry, ornamentation and organization must

of necessity be limited to a few basic forms, and it is logical to assume that the simpler forms, such as the plain wall or the pyramid in architecture, for example, would be developed first among any people commencing to make permanent structures; similarities may be merely accidental. Any such innovation in an advancing civilization might just as well represent an autochthonous development as a derived or borrowed one, and this may well apply to many of the great advances in the history of man's development.

G. Elliot Smith's (28) categorical statement, "It does not seem to occur to most modern ethnologists that the whole teaching of history is fatal to the idea of inventions being made independently" in support of his claims that all American higher cultures were derived from Egypt via India, Malaysia and Polynesia, is merely [7] begging the question. The biological evidence is absolutely and wholly in favor of an independent development of agriculture in America, and if such a complex art as this, involving the domestication of plants and animals, selection, breeding, the use of fertilizers, the construction of terraces, and the application of irrigation could thus have been independently developed in America, there is every reason to believe that the higher cultures based on this agriculture could also have been so developed. As noted elsewhere, there is some biological reason for believing that agriculture in the New World may be even older than it is in the Old World.

In 1933, at the Fifth Pacific Science Congress (22) in Vancouver, I presented a paper on economic plants in relation to man in America, in which I developed the well-known biological fact that pre-Columbian American agriculture, on which all advanced culture in America was based and by which it was maintained, was strictly autochthonous in that it was based on strictly native American plants and animals. Not one of the several scores of plants involved was known in Europe or in Asia until after Columbus's voyage in 1492, even as none of the more numerous cultivated plants and domesticated animals native of Eurasia, except the dog, was known in America until after they were introduced by Europeans. With this absolute demarcation and the very great botanical differences between the American and the Eurasian cultivated food plants, my conclusion then, as it is now, was that early man must have entered North America over a northern route, bringing no agriculture and probably no knowledge of it with him; that once here he existed primarily as a nomadic hunter and fisher for many generations and until some time after he reached Mexico. It was only after he reached Mexico that he came in contact with the better food-producing plants amenable to cultivation. Later, here and in South America, after he developed a permanent food supply through the domestication of certain native plants and animals, he gradually developed the high civilization characteristic of Mexico, Yucatan, Central America, Bolivia and Peru, uninfluenced by any developments in Eurasia. In other words, agriculture and the civilizations based upon it in America were autochthonous.

Following the presentation of this paper in a discussion with a prominent ethnologist, a disciple of the extreme diffusionist group, I was frankly amused by the absolute lack of biological thought or [8] training on his

part as brought out in the discussion. His arguments against my conclusions were, briefly, that agriculture must have commenced in Egypt on the basis of barley seeds floating down the tributaries of the Nile from Abyssinia. As the waters receded, did not the barley plant grow and did not early man find here an annual self-sown crop of edible seeds for the taking? Was not this the real beginning of agriculture, and on the basis of this "natural" agriculture were not the higher types of culture developed? And from this center was not culture spread over the entire world even to America? A theory set up and vigorously supported, as illogical as any argument that the most extreme supporter of the Atlantis or the Mu theory could possibly devise. Any farmer's boy could have told him that barley seeds, and for that matter those of all cereals, sink at once or very soon after they are placed in water.

Intrigued with this remarkable hypothesis I find the probable source of it in the writings of Professor G. Elliot Smith (30), a leading modern exponent of the romantic extreme diffusionist theory, and his botany is no better than that of my Vancouver opponent. He claims that in the history of mankind there is a mystery that is insolvable unless we assume that the Egyptians were in reality the first of mankind to cultivate cereals. He assumed that barley and millet were native to the Nile valley and that the natural crop of barley, which was growing wild on the banks of the Nile, seems to have provided the lure to attract the earliest settlers in Egypt. On this assumption he then proceeds to explain that the crop would ripen at the beginning of the hot season; that the seeds would lie on the surface of the ground and retain their viability; and that after the floods subsided the young plants would appear above ground a few days after the water drained off.

Regarding the situation in the Nile valley, Mr. H. E. Winlock, Director of the Metropolitan Museum of Art, informs me that the Nile flood begins with the first slight rise in June in Upper Egypt, about the time of the solstice. The water begins to rise rapidly the latter part of July or early in August and is at its height about the first of September in Upper Egypt and at the head of the delta two weeks to a month later. The peak of the flood in any one place lasts from two weeks to a month.

[9] Since the whole of the valley floor is composed of mud from the river, obviously before the river was controlled there must have been times when the entire valley, from one desert to the other, was subject to the highest floods, and the greater part of the valley must have been covered by water for at least a month each year; and the lowest-lying parts were perennial swamps.

Thus we would have to postulate a remarkable waterproof barley seed that could stand immersion in water or in mud for several weeks and still retain its viability, for with all modern species and varieties of the cultivated cereals two weeks or less in mud or in water suffices to destroy the grain if it does not germinate within that period, a fact that all farmers, even the most primitive ones, know.

Incidentally, we should record the fact that the mud banks of the Nile were not merely open naked banks, for here the rank growing lacustrine and mostly perennial species would fully occupy the land as the flood

water receded, and these would effectively hold the land against invading plants in the form of short-lived annuals like the cereals. There are not now, and never were, within the period of man's development, natural habitats in Egypt that would warrant any botanist in claiming that any cereal was native of that country. And finally, not one of the numerous plants cultivated in ancient Egypt was native of Egypt; all were introduced into the Nile valley in ancient times by man, from regions where early agriculture long antedated even its beginnings in Egypt. Should not biology be given some consideration?

I have several times quoted de Candolle's (4) logical and judicial conclusions of 1883 as expressed in the closing paragraph of his classical "Origine des plantes cultivées": "Dans l'histoire des végétaux cultivés je n'ai aperçu aucun indice de communications entre les peuples de l'ancien et du nouveau monde avant la découverte de l'Amérique par Colomb." The trained biologist at once recognizes the implications of this simple statement. The evidence was so manifest that de Candolle did not consider it desirable or necessary further to amplify his statement, for in these few words he effectively disposed of the disciples of Atlantis, Mu, and the extreme diffusionists. Had there been effective contacts across the Atlantic or the Pacific or both, after the development of agriculture in either the New or the Old World, it is inevitable [10] that the contacting peoples would have transmitted at least the more important of the cultivated plants. It is axiomatic that expanding and colonizing peoples invariably take with them, to support their culture, the basic cultivated plants and domesticated animals on which they were dependent in their home lands, for a permanent food supply. This happened in prehistoric as well as in historic times. Before 1492 there was not a single basic cultivated food plant and not a single domesticated animal, except the dog, common to the two hemispheres. What is the significance of this simple but incontrovertible fact?

When we consider the beginnings of agriculture, and agriculture must have been a thoroughly established art very many centuries before advanced culture based upon it was possible, we find that it originated in certain favored regions remote from each other, and in each center based on certain definite and distinct plants, or on plants and animals, actually occurring as feral species, either actually in, or in close proximity to the regions wherein the art itself originated. All basic cultivated food plants and all domesticated animals were derived from wild species and adapted to man's needs long before the dawn of recorded history, some in this part of the world, some in that part, and all of them were originally of relatively restricted distribution as wild species.

The centers of origin of both agriculture and culture were peculiarly restricted. It is not in the great river valleys and broad plains that we find these origins, but rather in limited areas favored by a more or less equable climate, with no great ranges of temperature as between summer and winter, areas with only a limited amount of rainfall, and neither in the deep wet tropics nor in the equally unfavorable colder parts of the north temperate zone. Considering the world as a whole, these restricted favored areas were the highlands of Mexico, Bolivia and Peru in North and South America, parts of Asia Minor, parts of Central Asia, limited areas in north-

ern India, central and southern China, and perhaps Abyssinia. It is from these peculiarly restricted areas that all of our basic cultivated food plants and domesticated animals came, and it is in these same restricted areas that early advanced civilizations were developed. Most of Asia, Europe and Africa yielded little or nothing of importance, Australia nothing, North America north of Mexico nothing, and South America, outside [11] of the limited areas indicated above, very little of importance. In each region the agriculture, and the early advanced cultures based upon it, centered around a few distinctly important species, such as maize, the garden and lima beans, sweet potato and common potato in America, and wheat, barley, rye, oats, millet, sorghum, rice and other less important cereals, with certain vegetables and fruits in the Asiatic centers.

But was there any such thing as an unlimited diffusion of this agriculture? The definite answer is no. Within the limits of North and South America, and within the limits of Eurasia including Africa, many cultivated plants and some domesticated animals were very widely distributed at an early time; in fact, many of them attained an almost universal distribution, within one hemisphere or the other, before the dawn of recorded history. This was diffusion, but a diffusion limited by the boundaries of the one hemisphere or the other. It was the expanding and colonizing European nations that gave the impetus to universal dissemination of cultivated plants and domesticated animals, previous to that time there being absolute geographic limits to such distribution.

In America the early European explorers found our northern Indians cultivating maize, beans, the pumpkin, squash, sunflower, Jerusalem artichoke, tobacco and some other plants all originating far to the south, and mostly south of the limits of what is now the United States. In Eurasia cereals and other cultivated plants were likewise widely distributed at an early date, long preceding recorded history. Wheat and barley originating in Asia Minor were cultivated by the lake dwellers of Switzerland, and in neolithic times even as far north as Denmark.

Other important food plants are of relatively recent distribution. Rice in the Old World, for example, a plant of Asiatic origin, did not appear in cultivation in Europe until the fifteenth century, although it had reached Syria at the beginning of the Christian era, while the common potato, native of South America, had not reached Mexico before the arrival of the Spaniards, in striking contrast to maize, the sweet potato, garden beans, lima beans, squash, and pumpkin which were then very widely distributed in both North and South America.

Both in America and in Eurasia, when the biologist surveys the scene, he is impressed with the fact that everywhere agriculture [12] extended far from its limited places of origin long in advance of the higher cultures, originating in favored localities, that were based upon it. The basic food plants and certain domesticated animals and the art of caring for them were transmitted by diffusion from one people to another until agriculture affected the lives of large groups of less advanced peoples thousands of years before these same people were in any considerable degree affected by what we call culture. Everywhere the spread of culture failed to keep pace with the spread of agriculture.

There are evident implications in this condition, and from it certain definite conclusions may be drawn that while being of comfort to the conservative ethnologist, as confirming his views, should be equally disconcerting to the extreme diffusionist because they are absolutely and unequivocally opposed to his concept of the universal diffusion of culture. If there were such a phenomenon as the universal diffusion of advanced cultures, then long antedating such diffusion there would have been a general dissemination of the plants and animals basic to agriculture. We have seen that the limits of distribution of cultivated plants and domesticated animals were the boundaries of the eastern and the western hemispheres; we may logically conclude that these same geographic limits were effective barriers to the dissemination of cultures based on agriculture.

The biological evidence wholly and unequivocally supports the general thesis of the conservative ethnologists that America was peopled by early migrations from northeastern Asia to northwestern America. It is logical to assume that there was wave after wave of such invaders. Earlier migrants may well have entered America over this northern route long before anything approaching agriculture had been developed in the lands whence they came. In any case, even if they were acquainted with any type of agriculture, they would have lost all knowledge of the art in the long period of migration which was not consummated in weeks, months, or years, but literally involved generations. They were forced to travel and extend their range, as nomadic hunters and fishers, in a cold northern land inimical to agriculture, and even had these early invaders originally been agriculturists, which is unlikely, they would have lost all knowledge of the art in the course of their long continued extensive migrations. It is significant, however, that they brought [13] with them the common dog, man's race-old companion and helper in hunting. Any people reaching America from northeastern Asia, no matter at what period of development, could have made the passage only as non-agricultural groups.

Once in North America they could not have developed any effective agriculture until after they reached Mexico, and even there, only after many generations, probably some thousands of years, of association with the wild plants they later domesticated. The beginnings of agriculture in America were probably accidental, as they were in the Old World, but agriculture once established, the history of man's upward development here followed much the same sequence that it did in the Old World. On the basis of a permanent and dependable food supply it became possible for groups of people in favored localities to develop higher cultures characterized by what the early European explorers found in Mexico, Central America, Yucatan, Peru and Bolivia, types of civilization comparable to the higher types of culture that had been developed in various parts of the Old World.

Because of the remarkable demarcation of American as compared to Eurasian agriculture, not in methods, for the methods were the same—field and terrace culture, irrigation, adaptation of plants to varying conditions, the use of fertilizers, selection, and plant breeding—but in the domesticated plants and animals themselves, which, without exception, were native American species, the only logical conclusion that the biologist can draw is that agriculture in America was developed independently and was

not influenced in the slightest degree by any agricultural development in the Old World. As agriculture in America was autochthonous, we may assume that so also were the cultures based upon it. There is no evidence of any contacts across either the Pacific or the Atlantic, disciples of Atlantis, of Mu, closet anthropologists, near anthropologists, popular writers, the extreme diffusionists, and other sensational writers to the contrary notwithstanding, that in any manner affected the development of agriculture or of culture in America until after the advent of Europeans in the last decade of the fifteenth century. As Spinden (32) concisely expressed the matter in 1927:

"From all points of view, it appears that there are no sound reasons for the interpretation of history demanded by the romantic [14] school in the science that studies the origin of man and his institutions. It is safe to file a general demurrer against mummifications, the corvade, helioliths, lost continents, African jargon, elephant trunks, and all other sensational arguments which have formed the basis for theories of occult migrations and forgotten conquests. One might as well have distribution of culture by telepathy and intellectual osmosis."

One phase of this problem remains to be briefly discussed. Let us assume that agriculture and the civilizations based upon it are older in the Old than in the New World, although there is some important biological evidence in favor of agriculture being older in America than in Eurasia, in that the wild congeners of practically all European cultivated species are still known to occur in nature in their original homes, while in America, certain very important cultivated plants, of which maize is an excellent example, are absolutely unknown in a wild state (13). Assuming that by chance advanced peoples of Eurasia did reach America long in advance of Columbus, they brought no food plants with them. Unless they found here a distinctly developed agriculture it would have been utterly impossible for them to exist as civilized beings and thus affect in any way the advancement of culture in America. With all the agricultural knowledge of their own particular culture area at their command they simply could not locate, and develop as cultivated species, the few potential food-producing ones among the tens of thousands of native American species that they might observe. An extensive and intensive empirical knowledge of wild plants and their economic uses acquired through many generations of close contact with them would be an absolute prerequisite to the selection of any species for domestication under existing conditions of several thousand years ago. The number of native species used for food by the American Indians north of Mexico is graphically indicated by Yanovski's (39) recent list of over 1100 species in 444 genera and 120 families of plants, very few of which were ever cultivated.

It is one thing to theorize about the diffusion of culture, but the actual implantation of culture on an alien people by casual contacts implicated by supposed pre-Columbian voyages across the Pacific or the Atlantic is quite another matter. If force be available, such as was the case with the early Spanish explorers, who [15] were supported by supplies from and contacts with the homeland, this is one thing, but accidental contacts such as those predicated by the enthusiastic but often illogical diffusionist,

across the vast expanses of the Pacific and of the Atlantic, would be merely in the nature of forlorn hopes.

As a biologist somewhat familiar with the general facts of plant distribution, and with the limitations on such distribution, and more or less familiar with the history of cultivated plants, both those of the Old and of the New World, but with no training and experience in ethnology, I am bold enough to conclude, on the basis of the available biological evidence, that we are not warranted in attempting to explain pre-Columbian American cultures on the basis of any trans-Atlantic or trans-Pacific contacts, but rather that primitive man in America developed his agriculture on lines paralleling those of Eurasia and that it and the cultures that were eventually based upon it were strictly autochthonous. It is entirely unnecessary to invoke the early civilized peoples of Eurasia to explain early pre-Columbian civilizations in America.

After all, this is a plea for closer cooperation between biologists and ethnologists. It is often the simplest matter in the world to state a theory, and when one appeals to a non-biological group he may secure the general support of a considerable number of his colleagues to ideas that the biologist simply cannot accept. To prove a theory is a totally different thing, for one must so state his case that it will not only be logical, but in such a subject as the one under discussion the theory must conform to biological facts. In considering man, the ethnologist is dealing with a complex biological unit. Man's association with plants and with animals is race old, and what he has done with the numerous species of both plants and animals under domestication must or should be taken into consideration. Primitive man was an efficient economic botanist long before he was an agriculturist, as for thousands of years before he developed to the point of actually cultivating plants for food, he must have utilized the edible portions of wild species to supplement his food supply of game and fish. It was this slowly acquired empirical knowledge that enabled him eventually to select from many thousands of plant species the few that best met his needs and that were amenable to cultural treatment. In this art of selection he was a past master both in Eurasia and in America, for [16] modern man has added nothing of basic importance to the long list of plants and animals domesticated by primitive man long before the dawn of history.

FOOD PLANTS AND ANIMALS OF AMERICAN ORIGIN

A brief consideration of the strictly American species of cultivated plants will give us some graphic idea of the important contributions of early man in America to modern agriculture. It should be kept in mind that in the following long and rather impressive list not a single species was known in Europe or in Asia until the close of the fifteenth century. America produced but one cereal, but that one the most important maize or Indian corn. Other important food plants were:

Potato, sweet potato, cassava, all varieties of field and garden beans, as well as the lima, scarlet runner, tepari and yam beans, tomato, pepper, sunflower, Jerusalem artichoke, squash, pumpkin, arrowroot, peanut, chayote, papaya, avocado, pineapple, custard apple, soursop, cherimoya, guava, cacao, cashew, sapote, white sapote, sapodilla, star apple, and mamei.

These are now widely cultivated in appropriate regions in both hemispheres, some being strictly tropical, others also extensively planted in temperate regions. Particularly in South America, a number of other native species were and are still grown for food, but have not become of importance in other regions. They include:

> Ulluco (*Ullucus*), oca (*Oxalis*), anyu (*Tropaeolum*), yautia (*Xanthosoma*), llacou (*Polymnia*), arracacha (*Arracacia*), achira (*Conna*), jataco (*Amaranthus*) and quinoa (*Chenopodium*).

In Peru (12) alone it is estimated that about 70 native species had been domesticated in pre-Columbian times, although some of these were not food plants, including cotton, tobacco and various ornamental and medicinal species. Yet there is much evidence (3, 36) that leads one to believe that Mexico and Central America are more important as an original source of food plants than are the South American centers.

American contributions to domesticated animals were comparatively few, including only:

> Llama, alpaca, muscovy duck and guinea-pig in South America, and in Mexico the turkey.

ANIMALS AND FOOD PLANTS OF EURASIAN ORIGIN

Eurasia, particularly Asia as contrasted with America, yielded a very much larger number of cultivated food plants and domesti-[17]cated animals, but not one of these, except the dog, reached America before the end of the fifteenth century. Among the animals may be mentioned:

> Cattle, the horse, sheep, goat, swine, water buffalo, yak, camel, goose, duck, hen, guinea-hen, pigeon.

The food plants of Eurasian origin included many fruits and vegetables, and all true cereals except maize:

> Among the cereals wheat, barley, rye, oats, millet, Italian millet, pearl millet, sorghum, rice, teff, ragi and coix; for convenience, buckwheat, though not a true cereal, may be included. Among the vegetables the turnip, cabbage, rutabaga, rape, chard, mustard, radish, beet, parsnip, carrot, onion, leek, garlic, shallot, spinach, egg-plant, lettuce, endive, salsify, celery, asparagus, globe artichoke, pea, soybean, cow-pea, chick-pea, pigeon-pea, lentil, broad, hyacinth, and asparagus beans, taro, yam, sugar-cane, sesamum and various others. Among the fruits the apple, pear, plum, cherry, wine grape, apricot, peach, prune, olive, fig, almond, persimmon, quince, pomegranate, jujube, melon, watermelon, cucumber and in the warmer regions the banana, coconut, orange, lemon, pomelo, lime, date, mango, breadfruit, jak fruit, rambutan, litchi, longan, mangosteen.

Practically all the cultivated forage crops, including the hay grasses, clovers and alfalfa, are also of Eurasian origin.

CONCLUSION

In modern times, with steadily improving intercommunication between various parts of the world, man has become the most important single factor in the actual dissemination of plants. It cannot be too greatly overemphasized, however, that it was not until after the discovery of America in 1492 and the succeeding period of European colonial expansion that there was any important distribution of cultivated plants as between

Eurasia and America and *vice versa.* This fact has a very striking bearing on certain persistent claims that are made over and over again regarding the origins of pre-Columbian civilization in America, and may be accepted as reasonably good evidence that no ancient contacts between the two continents existed.

We are apt to take our cultivated plants and domesticated animals for granted, seldom giving a thought as to whence they came, when, where, and by whom they were originally domesticated, when and how they were disseminated, and whether major distribution took place in historic or in prehistoric times. We forget that a species of distinct economic importance, once introduced into a new region, may spread with remarkable rapidity, as illustrated by the fact that maize reached western China over a long overland [18] route from the Mediterranean basin within 25 years after it was introduced into Spain from America, or by the world-wide spread of the use of tobacco, through the influence of the common European sailor following European contacts with America. We often fail to realize that several scores of more or less important cultivated species of food plants domesticated in America by early man, including several of the most important ones in the entire world, were, until about four hundred years ago, utterly unknown to the agriculturists of the Old World, even as the larger number of species domesticated in Eurasia were unknown in America.

In the general field of ethnobotany much still remains to be accomplished. Here is a fruitful field inviting the cooperative work of ethnologists, archeologists, comparative philologists and botanists. But it should be remembered that in no field impinging on systematic botany are there more pitfalls to be avoided than this seemingly simple one of man in his relationships to plants. Let us again quote G. Elliot Smith (28) who, in appealing to ethnologists to accept his views on Egypt as the one and only source of origin of pre-Columbian American culture states: "All that I aim at achieving at present is to persuade ethnologists to do what is constantly being done in every *true* science, namely, impartially to examine the foundations upon which its theory rests. If they will consent to do this I have no doubt as to the outcome."

I commend to all ethnologists, including the conservative group as well as the extreme diffusionists, the critical consideration of this intriguing problem of man in his relationship to cultivated plants and domesticated animals, with particular reference to their places of origin, and when, by whom, and how they were disseminated. What he has done with them under domestication has a distinct bearing on problems appertaining to diffusion of culture. Whenever possible to do so I also recommend that preconceived theories be subjected to the acid test of biological facts; that, the author of the passage quoted above manifestly failed to do.

REFERENCES AND SELECTED BIBLIOGRAPHY

1. **Beccari, O.** The origin and dispersal of *Cocos nucifera.* Philip. Jour. Sci. **12:** Bot. 27-43. 1917.
2. **Bessmertny, A.** Das Atlantisrätsel; Geschichte und Erklärung der Atlantishypothesen. 1-212. 1932.
3. **Bukasov, S. M.** The cultivated plants of Mexico, Guatemala, and [19] Colombia. Bull. Appl. Bot. Genet. Pl.-Breed. Suppl. **47:** 1-553. 1930.
4. **Candolle, A. de.** Origine des plantes cultivées. 1-377. 1883.

5. ——. Der Ursprung der Culturpflanzen. 1-590. 1884.
6. ——. Origin of cultivated plants. 1-468. 1885.
7. **Chiovenda, E.** La culla del Cocco. Contributo alla ricerca della patria originaria della Palma de Cocco. Webbia **5**: 199-294. 1921; 359-449. 1923.
8. **Churchward, J.** The lost continent of Mu, the motherland of man. 1-316. *illus.* 1926; another edition, 1-335, *illus.* 1931.
9. ——. The children of Mu. 1-266. *illus.* 1931.
10. **Cook, O. F.** The origin and distribution of the cocoa palm. Contr. U. S. Nat. Herb. **7**: 257-293. 1901.
11. ——. History of the coconut palm in America. Contr. U. S. Nat. Herb. **14**: 271-342. 1910. (See Beccari, Chiovenda.)
12. ——. Peru as a center of domestication. Tracing the origin of civilization through domesticated plants. Jour. Hered. **16**: 23-46, 95-110. 1925.
13. ——. The debt of agriculture to tropical America. Bull. Pan Am. Union. 1930. Republished in Ann. Rep. Smithsonian Inst. 1931. 491-501. 1932.
14. **Cooper, G. H.** Ancient Britain, the cradle of civilization. 1921.
15. ——. The Druid bible. Universal key to historic symbolic records. 1-189. *illus.* 1936.
16. **Donnelly, I.** Atlantis; the antediluvian world. 1-280. *illus.* 1882.
17. **Gattefossé, J.** Bibliographie de l'Atlantide et des questions connexes (géographie, ethnographie et migrations anciennes, Atlantique et Méditerranée, Afrique et Amérique) fixité ou derivé des continents, déluges, traditions, etc. 1-111. 1926.
18. **Knotel, A.** Atlantis und das Volk der Atlanten; ein Beitrag zur 400-jährigen Festfeier der Entdeckung Amerikas. 1-418. 1893.
19. **Merrill, E. D.** The phytogeography of cultivated plants in relation to assumed pre-Columbian Eurasian-American contacts. Am. Anthropol. **33**: 375-382. 1931.
20. ——. Crops and civilizations. Nat. Hist. **33**: 235-250. *illus.* 1933.
21. ——. Crops and civilizations. Bull. Torr. Bot. Club **60**: 323-329. 1933.
22. ——. The problem of economic plants in relation to man in pre-Columbian America. Proc. Fifth Pacific Sci. Congr. 759-767. 1934.
23. ——. Scuttling Atlantis and Mu. Am. Scholar **5**: 142-148. 1936.
24. ——. Plants and civilizations. Sci. Monthly **43**: 430-439. 1936; also in "Independence, Convergence, and Borrowing." Harvard Tercent. Publ. 33-43. 1937.
25. ——. On the significance of certain oriental plant names in relation to introduced species. Proc. Am. Philos. Soc. **78**: 111-146. 1937.
26. **Ogilby, J.** America; being an accurate description of the New World. [1-6]. 1-629. *illus.* 1670; another edition 1671.
27. **Perry, W. J.** The children of the sun; a study in the early history of civilization. 1-551. *16 maps.* 1923.
28. **Smith, G. E.** The origin of pre-Columbian civilization in America. Science, n.s. **44**: 190-195. 1916; 241-246. 1917.
29. ——. Elephants and ethnologists. 1-135. 1924.
30. ——. Human history. 1-472. 1929.
31. ——. The influence of ancient Egyptian civilization in the East and in America. *In:* The Making of Man. 393-430. 1931.
[20] 32. **Smith, G. E., Spinden, H. J., Malinowski, B.,** and **Goldenweiser, A.** The diffusion controversy. 1-106. 1927.
33. **Spence, L.** The problem of Atlantis. 1-232. 1925 (revised edition).
34. ——. Atlantis in America. 1-213. 1925.
35. ——. The history of Atlantis. 1-238. 1926.
36. **Vavilov, N. I.** Mexico and Central America as the principal center of origin of cultivated plants of the New World. Bull. Appl. Bot. Genet. Pl.-Breed. **26**(3): 133-199. 1931.
37. ——. The rôle of Central Asia in the origin of cultivated plants. Bull. Appl. Bot. Genet. Pl.-Breed. **26**(3): 1-44. 1931.
38. **Wulff, E. V.** Introduction to the historical geography of plants. Bull. Appl. Bot. Genet. Pl.-Breed. Suppl. **52**: 1-356. 1932.
39. **Yanovski, E.** Food plants of the North American Indians. U. S. Dep. Agr. Miscel. Publ. **237**: 1-83. 1936.

INDEX KEWENSIS IN IMPROVED LOOSE LEAF LEDGER FORM*

[137] In 1932, at the New York Botanical Garden, I initiated the pasting of all entries in Index Kewensis and its seven supplements then published, in loose leaf ledger form, the first time that the task was consummated on the basis of modern business technique in any institution. The actual work was done under the personal supervision of Mr. G. L. Wittrock, by assistants provided by the Emergency Work Bureau of New York City. Since the New York set was completed two additional supplements have been issued. This fundamental work, now consisting of over 6,000 folio pages with about 700,000 binomial entries is the most used single work in all institutions where systematic botanical work is a major activity. The importance of a single generic sequence is at once realized when one considers that if the several *addenda* and *emendanda* be included, there are as many as fifteen different generic entries in the eleven volumes now published for some groups. This means that one must, or should, search in fifteen different places when consulting the work when one is interested in determining whether or not such and such a specific name has been used, and if so, where it was first published.

In February, 1939, the task of pasting up all entries in the original work and its nine supplements in one generic sequence was initiated at the Arnold Arboretum and was completed early in June. The improvements in the Arnold Arboretum set over the style selected at New York are in the adaptable auto-flex four post binders manufactured by the Wilson-Jones Company, pig skin binders rather than buckram being selected for permanency; chain lock mechanism for holding the sheets firmly in place and providing for future easy addi-[38]tions of extra sheets; the individual sheets reinforced by tough cloth strips on the binding edge; and a very much greater amplification of the pasted-in data thus providing ample space for future additions without breaking sequences as additional quinquennial supplements appear; and in the case of all large genera, an indefinite amount of space for this purpose.

In preparation for this work two complete sets of Index Kewensis and its nine supplements were clipped. Each entry was stamped "IK", "IKS1", "IKS2", etc., and when this part of the task was completed, the clippings were arranged alphabetically under the generic heads, and chronologically in accordance with the sequence of the several supplements. After carefully checking for alphabetic sequences and proper spacing between entries, the items were pasted on the standard sheets selected. The estimated amount of space for future additions under each small genus was approximately determined by scanning the several Supplement entries, but all large and medium sized genera were left "hanging" for indefinite future additions, the blank part of the last page to be filled first and then new sheets, as necessary, to be inserted. In all large genera the entries were pasted in solid, covering both sides of the sheet, regardless of the amount of

* E. D. Merrill, "Index Kewensis in Improved Loose Leaf Ledger Form" (Bulletin of Popular Information, Arnold Arboretum, IV, 7:37-40, 1939).

space left on any last page, but except for such groups the items were pasted on one side of the sheet only. Thus in one of the open loose leaf ledger books shown in the illustration [reproduced in the original], it will be noted that the third and last page of *Gladiolus* is nearly full; but when the tenth supplement appears, the small amount of remaining space will be used and then a new sheet will be inserted to take the remainder and future additions.

When Supplement ten appears, five years hence, it may be necessary to break sequences to provide for some of the newly published genera, and occasionally it may be necessary to do this in a few cases where a very large number of new binomials under any old generic name may be published. The breaking of sequences can, however, be readily obviated by steaming the sheets, removing the pasted entries, and expanding the arrangement to meet future contingencies. This provision for the insertion of additional sheets is the great advantage of the modern loose leaf ledger format over the older system of permanently bound volumes, such as that initiated at Kew many years ago. The system of a single sequence is, for practical purposes, superior to the form used at the Rijks Herbarium, Leiden, where the generic entries were first sorted into families, and then arranged alphabetically by genera, each genus commencing a new page.

[40] The page size selected is the same as for the New York set, 17 by 14 inches, four column format. The sheets are arranged in one generic sequence occupying six binders, each about five and one-half inches thick, about 550 sheets to a binder. The net advantages to the numerous users of this indispensable work is the actual saving of a vast amount of time when one has to check the published binomials in any genus of flowering plants, the time actually saved in this connection often amounting to as high as 90 percent.

—XVII—

A SIMPLE CHANGE IN NAME*

[1] Our "Bulletin of Popular Information" has always been an unsatisfactory periodical to cite, because of the form of its title, which reads: "Arnold Arboretum, Harvard University, Bulletin of Popular Information." Moreover, for no very obvious reason, in the twenty-nine years of its publication it has attained four series, and for clarity it is necessary to cite the series as well as the volume. Initiated in May, 1911, sixty-three unpaged numbers form the first series, this run closing in November, 1914. In 1915, a new series was commenced with volume one and was continued for twelve years, closing with volume twelve in December, 1926. Series three was initiated with volume one in 1927, and closed with volume six in 1932. The fourth and last series was commenced with volume one in 1933, and was closed with volume eight in 1940.

In scanning the many thousands of entries in such a comprehensive reference work as the "Union List of Serials in Libraries of the United States and Canada," one notes that an overwhelming majority of the periodical titles stress the name of the sponsoring organization in their titles, whether published by a society or an institution. My attitude is that in general a single name is better than a long and cumbersome title, and in many cases single name titles would have established and maintained the institutional or organizational prestige just as well as the longer explanatory title—and, of course, would be infinitely simpler to cite. One unnecessarily long title that I replaced with a single word one was the following: "University of California Publications. The Agricultural Experiment Station of the College of Agriculture Technical Paper No. —." In 1925, this series was closed and the new [2] title "Hilgardia" was selected, with an explanatory subtitle, "A Journal of Agricultural Science published by the California Agricultural Experiment Station," to replace the "Technical Bulletin" series with the long and cumbersome name, and "Hilgardia," named in honor of the first Director of the California Agricultural Experiment Station is now in its thirteenth volume. In 1931, a new technical periodical was established at the New York Botanical Garden, and for this the single word name "Brittonia" was selected in honor of the first Director of the Garden, Dr. Nathaniel Lord Britton, with an explanatory subtitle, "A Series of Botanical Papers published by the New York Botanical Garden."[1] And now the old name of our Bulletin of Popular Information is replaced with a one-word title "Arnoldia" honoring Mr. James Arnold whose initial bequest of $100,000.00 in 1868 led to the establishment of the Arnold Arboretum in 1872.[2]

In the short paper referred to above on one-name periodicals, about forty one-word or essentially one-word titles for well-known technical periodicals are listed where the name itself indicated the general field

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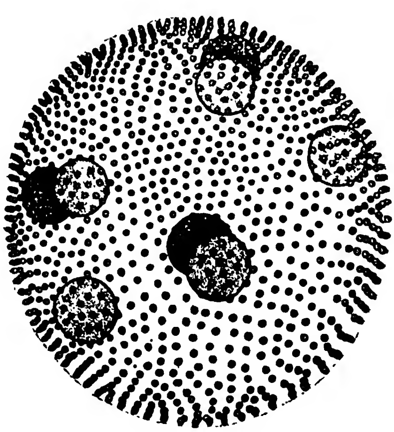
* E. D. Merrill, "A Simple Change in Name" (Arnoldia 1:1-2, 1941).

[1] Merrill, E. D. One-name periodicals. Brittonia 1: 1-5. 1931.—Chron. 10:239.

[2] Raup, H. M. The genesis of the Arnold Arboretum. Arnold Arb. Harvard Univ. Bull. Pop. Inf. IV. 8: 1-11. pl. 1. 1940.

of the publication. Following this, another series of about forty one-name titles is given, where the names were, for the most part, derived from those of individuals prominent in botanical and horticultural science, such as "Adansonia," "Bonplandia," "Candollea," "Grevillea," "Hedwigia," "Linnaea," "Malpighia," "Sieboldia," "Torreya," and others. In our own case we are fortunate in being able to derive a short, euphonious, one-word title from the name of the individual whose broad vision and interest led him to provide funds, devised to the trustees of his estate, that led to the establishment of the institution that bears his name. It is believed that the new name "Arnoldia" with its explanatory subtitle, "A Continuation of the Bulletin of Popular Information of the Arnold Arboretum, Harvard University," will be far more satisfactory than the somewhat cumbersome one that it replaces. It will, at the same time, reflect proper institutional credit on its sponsoring institution, the Arnold Arboretum, and on its holding body, Harvard University, as long as we are able to maintain it as a medium of publication that serves the needs of its supporters.



MAN'S INFLUENCE ON THE VEGETATION OF POLYNESIA, WITH SPECIAL REFERENCE TO INTRODUCED SPECIES*

[629] This paper is not predicated on the destructive agency of man in reference to the vegetation of Polynesia, for this is evident wherever he has become a dominant factor not only in Polynesia, but in practically all other parts of the world. The need for agricultural lands, the demand for forest products, the devastating effects of extensive fires largely due to man's presence, his thoughtlessness, and his carelessness, the actual introduction of destructive herbivorous animals and the deliberate or accidental introduction of numerous plant species and plant pests are most important factors in reference to the persistence and preservation of natural vegetative areas throughout Polynesia as elsewhere. It is clear that of all the factors effecting the vegetation of the world man is by far the most important and most destructive one, except, as here and there, climatic changes over long periods of time naturally alter the existing vegetation; but even here, under modern conditions, the replacement species are now more apt to be man-introduced aliens than indigenous species.

With the elimination of man's destructive tendencies from the present discussion, my theme resolves itself into a consideration of his activities in the deliberate and accidental introduction and dissemination of alien plants with special reference to Polynesia. Here, again, in the world at large, in the present-day dissemination of plant life, man stands as the most important single factor, for he has been able to transcend the limitations on natural distribution of plants by such agencies as the air, water, birds, animals, and various minor categories, through the deliberate dissemination of economic and ornamental plants either in the form of seeds or as living plants, and by the accidental (but occasionally deliberate) distribution of noxious species.

In the temperate and tropical parts of both hemispheres, for certain types of vegetation, particularly agricultural lands, fallow fields, waste places in and near settlements, and for certain types of natural open grass lands and second-growth forests, we approach conditions of more or less uniform types of vegetation both in temperate regions and within the tropics because of the introduction and naturalization of hundreds of species alien to this or that region after man's influence became dominant in the field of plant distribution. Some of these universally distributed species were originally native of the New World, others of the Old World, but wherever they have become naturalized in their new homes they have as a rule become thoroughly domesticated and are frequently dominant. Thus the European botanist visiting the eastern United States will note that the majority of the dominant species in the open fields, meadows, and waste places are

* E. D. MERRILL, "Man's Influence on the Vegetation of Polynesia, with special reference to Introduced Species" [Proceedings of the Sixth Pacific Science Congress 4:629-639, 1940(1941)].

those with which he is thoroughly familiar at home, aliens in America, mostly introduced from Europe from time to time during the past three centuries. The botanist familiar with the Mediterranean flora visiting California will be impressed by the dominance of Mediterranean types everywhere in the settled areas of this part of western America. Within the tropics, the individual familiar with the flora of the environs of such cities as Calcutta, Colombo, Rangoon, Batavia, Singapore, Manila, or Honolulu, on visiting Vera Cruz, San Juan, Havana, or other cities in tropical America or in tropical Africa, will be impressed by the fact that most of the species cultivated for economic and ornamental purposes in tropical America and tropical Africa, many of the species of grasses and sedges, and most of the weeds and weedlike plants dominant in the open lands are those with which he was thoroughly familiar in the Oriental cities named.

[630] Too often, except among a rather limited group of botanists who are familiar with the general principles of plant distribution, the impression prevails that most plant species, no matter where now found, were always thus widely distributed. Thus in relation to the cultivated species basic to civilization, a certain school of anthropologists known as the diffusionists have ignored the problems of the distribution of basic cultivated food plants and domesticated animals, on which all high civilizations were based and by which they are maintained. They do not realize, and apparently the extremists will not admit, that the pre-Columbian civilizations in America were based absolutely and wholly on a strictly American agriculture, which in turn was based wholly on native American plants; and what is even more significant is the incontrovertible fact that not one of the numerous American species domesticated by the early Americans was known in Europe or in Asia until after they were introduced from America following the last decade of the fifteenth century, even as none of the more numerous cultivated Eurasian species was known in America until after they were introduced by the European explorers and colonists. Not a single important species of the several hundred cultivated for food transcended the limits of the eastern or western hemispheres until after the close of the fifteenth century.

Polynesia offers an almost ideal field for a study of the introduced elements, partly because of the widely separated groups of islands, partly because of the relatively late period that the region was originally populated by man,[1] partly because of the fairly extensive collections of botanical material made in certain key islands in the last third of the eighteenth century, and again because actual European colonization and settlement, except in the Marianne and Caroline Islands, was not initiated much more than 100 years ago, although various exploring expeditions, whalers, and traders visited the numerous island groups at various times, and missionary activities were initiated about 150 years ago.

[1] **Buck, P. H.** Vikings of the Sunrise (pp. i-xiii + 1-335, illus., 1938) concludes that the ancestors of the present Polynesian race occupied the central Pacific islands in the fifth century A.D. but calls attention to the fact that they were preceded by an earlier, somewhat more primitive nonagricultural people. He states (p. 10): "The widely spaced islands between Fiji and South America remained unvisited by man until late in the world's history."

Hallier[2] has projected numerous land bridges connecting various parts of Polynesia with each other and with the lands to the east and west, to explain the presence of certain native types of vegetation in Polynesia. It is, however, by no means proved that such land bridges ever existed or are, or were, even necessary to explain the present Polynesian flora. Numerous papers have been written to explain the origins and relationships of this flora, but in many cases it seems to be evident that the individual authors theorized on very little tangible evidence and had no very wide knowledge either of the Polynesian flora as such, and even less knowledge of that of the lands to the east and the west. As to the American and the Asiatic-Malaysian-Australian elements, it seems to be evident that the former are relatively weak and, as one would naturally expect, largely confined to eastern Polynesia, while the Asiatic-Malaysian-Australian elements are dominant, but decrease gradually in importance as one proceeds from the west to the east. Essentially, the present Polynesian flora is made up of various indigenous elements, American, Antarctic, and Asiatic-Malaysian-Australian types, that is, infiltrations from the east, the south, and the west, plus an ever-increasing number of introduced and naturalized elements. There seems to be an increasing amount of evidence [631] that a considerable part of the Polynesian flora may have been originally derived from ancient Antarctica.

The introduced and naturalized element in any region may be treated from several standpoints, such as the historical, systematic, and economic. Within Polynesia we have a very long period of no contacts with outside areas, followed by what we may call the prehistoric period when man commenced to migrate into the Pacific basin from the west, probably not antedating 2000 years, the present Polynesian race expanding throughout the Polynesian area from the fifth century onward. Another period may be defined as the historical one, commencing with the first European explorations in the sixteenth century. Perhaps a third period might be recognized, covering the past century or less, dealing with European agricultural development in the major island groups, but after all this is merely a continuation and amplification of the historical period.

Seemann[3] seems to have been the first botanist to discuss the introduced element in Polynesia, particularly in Fiji. His thesis that the Polynesian islands acted as a bridge by means of which the weeds of the New World reached the Old World, and *vice versa,* is not tenable unless we interpolate the agency of man. While some American weeds were undoubtedly introduced into Polynesia direct, others have certainly come in via the Indo-Malaysian region, the same route by which the Indo-Malaysian weeds attained Polynesian distribution. Seemann states: "Polynesia, situated as it is between three great continents, presents a most interesting problem with regard to its weeds, which, however, cannot be satisfactorily solved until the whole flora shall have been properly worked out; but we make an attempt to deal with it so far as Viti is concerned. There we have 64 species, which may be regarded as troublesome weeds. Some of these are diffused

[2] **Hallier, H.** Ueber frühere Landbrücken, Pflanzen und Völkerwanderungen zwischen Australasien und Amerika, Med. Rijks Herb. Leiden, 12:1-32, 1912.

[3] **Seemann, B.** Flora Vitiensis, 1865.

throughout the tropics; but the bulk of them (48) are common to America, only 16 being strictly confined to the Old World, principally Asia. It may be argued that several of those found in America are also common to Asia, or that Asia is their true native country; but even admitting this reduction, it must be conceded that the bulk of the weeds of Viti is of American origin, or at all events, is now found in America. This is the more singular as the majority of the species of these Islands, as far as they are not endemic, is Asiatic. Polynesia seems to have acted as a bridge by means of which the weeds of the Old World crossed over to the new, and those of the New World to the Old; and the fact that American weeds show a greater disposition than Asiatic to spread in Viti must be held to prove, if my theory be sound, that Viti is to American weeds altogether virgin ground."

Seemann confined his list strictly to those plants that are characterized by their ability to spread on land cultivated or otherwise disturbed by man. Of 64 species listed, about 50 occur in America, although only about 12 of these are definitely of American origin, while more than 30 are definitely of Indo-Malaysian origin. We might compare the Polynesian islands as steppingstones rather than as a bridge, but even with this comparison the analogy is scarcely better than Seemann's idea of a bridge unless we add the agency of man; this for the simple reason that no matter how efficient the methods of dissemination are in the various species involved *over continuous land areas,* none of them are able to traverse wide expanses of the sea unaided. In other words, natural means of dissemination of most weed seeds fail when distribution from one island group to another is involved; but once introduced into a new territory to which the plants are adaptable, they often spread with remarkable speed and facility.

[632] Rock and others have discussed various phases of the subject as affecting Hawaii. I have given considerable attention to the subject for Guam,[4] and Ridley[5] has treated the subject in a general way but without much special reference to Polynesia. Guppy[6] gave much attention to the subject in his extensive studies on seed dispersal in Polynesia.

For the Philippines, with special reference to the flora of Manila, many data were given by me,[7] while recently Backer[8] has published a very significant list of American species naturalized in Java. Various other authors have contributed to the general subject.

The conclusions of F. B. H. Brown,[9] who has discussed in a somewhat confused manner the problem of introduced species in southeastern Polynesia, with particular reference to origins and time of introduction and of

[4] **Merrill, E. D.** An Enumeration of the Plants of Guam, Philippine Jour. Sci., 9:27-36, 1914.

[5] **Ridley, H. N.** The Dispersal of Plants Throughout the World (pp. i-xx + 1-744, 1930); "Dispersal by Human Agency," pp. 628-659.

[6] **Guppy, H. B.** Observations of a Naturalist in the Pacific (2:i-xxviii, 1-627, 1906), plant dispersal.

[7] **Merrill, E. D.** Notes on the Flora of Manila, with Special Reference to the Introduced Element, Philip. Jour. Sci., 7:145-208, 1912.

[8] **Backer, C. A.** A Revision of Kuntze's Types of New Javan Species, Brittonia, 3:85-87, 1938.

[9] **Brown, F. B. H.** Flora of Southeastern Polynesia. I. Monocotyledons, Bishop Mus. Bull., 84: 1-194, 1931; III. Dicotyledons, 130: 1-386, 1935.

dissemination of various species, do not impress me as being very convincing in certain details. He claims in his discussion of about 190 introduced species that over 80, or somewhat less than one-half, were probably brought into this area by Polynesian immigrants before the arrival of the first Caucasian explorers in 1595, which I believe cannot be substantiated by any tangible evidence. From what is definitely known regarding many of these species, as to their origins, there seems to be little justification for these general conclusions. His lists are badly confused. In his first one on page 7 (1935) at least seven are ocean-distributed species, that is, those of *natural* pantropic distribution, and in his third list, page 8, at least ten belong in the same category. There seems to be no proof that many of these supposedly early introductions in the several lists actually occurred in Polynesia previous to the arrival of the Europeans. On the contrary, the very fact that most of the weeds were not collected by Banks, Solander, Forster, and Nelson (1768-80) rather clearly indicates that they did not then occur in Polynesia. It may be that some of the species were, as Brown claims, introduced into cultivation in southeastern Polynesia by early Polynesians, but if so they undoubtedly came from local, not exotic sources, that is, from somewhere within Polynesia itself. Examples are *Casuarina equisetifolia* Forst., *Erythrina indica* Lam., *Cordia subcordata* Lam., *Colubrina asiatica* Linn., *Hibiscus tiliaceus* Linn., *Thespesia populnea* Corr., *Terminalia catappa* Linn., *Barringtonia asiatica* (Linn.) Kurz, and *Morinda citrifolia* Linn. These, of course, have nothing to do with the weed flora, and most of them are very strange "cultivated" species. They are all strand trees or shrubs, universally distributed along the seashores of the Old World (a few extending to America) from tropical East Africa through Malaysia to the extreme eastern limits of Polynesia. The inclusion of the American *Carica papaya* Linn., and of the Asiatic *Cucumis melo* Linn., as aboriginal introductions is at least surprising, and if correct might be somewhat disconcerting.

Fortunately we have for certain parts of Polynesia authentic records as to the occurrence of certain species as early as 1768-80 from the collections made by Banks, Solander, Forster, and Nelson. The Banks and Solander data are [633] preserved in manuscript form in the library of the British Museum (Natural History)[10] and through the courtesy of the librarian of that institution I have been supplied with photostat copies of several of the items. Supplementing these manuscripts are the several publications by G. Forster and by J. & G. Forster, based on collections made during Cook's voyage and published from 1776 to 1797.[11] While the number of Polynesian

[10] **Solander, D. C.** Plantae Ins[ularum] Ocean[i] Pac[ifici]. Pp. 30. Plantae Otaheitenses. Pp. 181; Index speciminum plantarum Insulae Otaheitensis. Pp. 24; Index . . . plantarum Insulae Otaheite reliquarumque insularum Oceani Pacifici. Pp. 32; Catalogus plantarum Insulae Otaheite. Pp. 24; Primitiae florae insularum Oceani Pacifici sive catalogus plantarum in Otaheite, Eimeo, Otaha, Huaheine, & Ulaietea a.c. 1769 &c. Pp. 199-380; [Manuscript lists of plants collected . . . in the order in which they were placed in drying books for carriage home]. Pp 29. 1769-82.

These items form a part of Solander's unpublished manuscripts in the library of the British Museum, Natural History. They are based on material collected by Banks and Solander during Captain Cook's first voyage, 1768-71.

[11] See the list in **E. D. Merrill**, Polynesian Botanical Bibliography, 1773-1935, Bishop Mus. Bull., 144:82, 1937.

species actually secured by these pioneer collectors was relatively small, yet they are significant. One would naturally expect that the collections would for the most part be made in easily accessible areas near the coast and in the vicinity of settlements. Thus one may logically assume that the collectors would have secured most or all of the weeds of cultivation then existent in the island groups explored. These lists have been discussed by Guppy[12] and briefly by Ridley,[13] the former recording 37 species of weeds collected by Banks and Solander, the Forsters, and others who visited the islands and who first investigated the flora (1768-1780). It is worthy of note that all but two of the plants Guppy classes as weeds are of Indo-Malaysian origin, although most of them now occur also in America. This corresponds to the accepted fact that the principal food plants of the Polynesians were of Malaysian origin. If the cultivated food plants were introduced from Malaysia, as was certainly the case, then one would naturally expect a certain number of Indo-Malaysian weeds to accompany them. Had the food plants of the Polynesians been of American origin, then we might, with equal reason, have expected to find a higher percentage of American species among the aboriginal Polynesian weeds.

Attention is called to the fact that Cook's voyages, when the Banks, Solander, and Forster Polynesian collections were assembled, were by no means the first explorations of Polynesia. Guam was discovered by Magellan in 1521, and after Philippine colonization was commenced by the Spaniards some three decades later, the galleon trade route between Acapulco and Manila via Guam operated until about 1824, a period of over 250 years. The effect of this long-continued trade connection is shown by the large number of American weeds and economic species introduced into Guam and the Philippines over this ancient trade route and by a corresponding list of Oriential species that were introduced into Mexico. Aside from these normally annual eastward and westward trips across the Pacific, various early Spanish, Dutch, English, and French explorers visited Polynesia from 1567 to 1767, including Alvarez de Mendano (1567), Drake (1577), Cavendish (1586), Mendana de Neyra (1595), Van Noort (1598), Quiros (1605), Spilbergen (1616), Schouten and Le Maire (1615), Hermite (1625), Dampier (1686), Cowley (1685), Clipperton (1691), Rogers (1710), Roggewein (1721), Anson (1742), Byron (1764), and Bougainville (1767). These explorers in general came into the Pacific from the American side and with from one to several ships each. If they did [634] not introduce certain weeds of American origin into some of the Polynesian islands, this would be most surprising indeed. Thus in these early voyages we have a logical explanation of the presence of certain weeds of indubitable American origin in Polynesia before the year 1768; yet even as the Polynesians themselves may possibly have introduced the sweet potato from America into Polynesia, at the same time they may also have introduced a few American weeds.

The fact should be noted that the number of weed species in any particular island tends to increase rapidly as settlement progresses. Thus in the

[12] Guppy, H. B. Observations of a Naturalist in the Pacific, 2:415, 1906; plant dispersal.

[13] Ridley, H. N. The Dispersal of Plants Throughout the World, pp. 633-634, 1930.

case of Christmas Island, in the Indian Ocean south of Java, Ridley[14] calls attention to the fact that before any settlements were made on the island, that is, up to 1888, no weeds occurred there. Mr. Ross settled on the island in 1888; in 1890 four species of weeds were recorded, in 1897 twelve, and in 1904 thirty—a record of weed introductions covering sixteen years only.

We note from the preceding paragraph that once civilized man occupies a virgin island, the number of weed species increases with surprising rapidity. This has unquestionably been true throughout the period of the actual peopling of Polynesia during the past 2000 years or so, the process being greatly accelerated after the actual European occupation of certain islands occurred. Certain weeds, once introduced into a new region, remain very local over long periods of time. Thus *Schrankia quadrivalvis* (Linn.) Merr., introduced into the Philippines at least 150 years ago from Mexico, still remains abundant in the Philippine locality whence it was first recorded in 1837, but has scarcely spread out of this one small area. *Mitracarpum hirtum* DC., *Ammannia coccinea* Rottb., and *Sida glomerata* Cav. were early Mexican introductions into Guam, but other than the first, which also occurs in the Society Islands, have scarcely spread in the Old World. Another series of Mexican introductions into Guam and the Philippines includes *Malachra fasciata* Jacq., *Hyptis spicigera* Lam., *Blechum pyramidatum* (Lam.) Urb. (occurs also in Formosa), *Anredera scandens* Moq., *Rotala ramosior* Koehne, and *Parosela dalea* (Linn.) Britton, which in the past few hundred years have become common in these two island groups, yet have scarcely extended their ranges outside the areas noted; although other species such as *Hyptis decurrens* (Blanco) Epling, *Ipomoea triloba* Linn., *Elephantopus mollis* HBK. and others now commence to appear in such neighboring regions as Formosa, Hongkong, Indo-China, Borneo, Singapore, Java, and the Moluccas.

In contrast to these weeds of relatively "slow" dispersal, there is a much larger series that exhibit exceedingly rapid dissemination, unquestionably because of their superior adaptations to methods of seed dispersal, perhaps supplemented in certain cases by their greater adaptability to various conditions. Illustrative of this class are *Paspalum conjugatum* Berg., *Chloris barbata* Sw., *Andropogon aciculatus* Retz., *Hyptis suaveolens* Poir., *Hyptis brevipes* Poir., *Heliotropium indicum* Linn., *Solanum nigrum* Linn., *Ageratum conyzoides* Linn., *Emilia sonchifolia* Linn., *Portulaca oleracea* Linn., *Eichhornia crassipes* Solms, *Bidens pilosa* Linn., *Synedrella nodiflora* Gaertn., *Sida acuta* Burm. f., *S. rhombifolia* Linn., *S. cordata* Linn., *Waltheria americana* Linn., *Euphorbia hirta* Linn., *Crotalaria incana* Linn., *C. mucronata* Desv. (*C. striata* DC.), *Amaranthus viridis* Linn., *A. spinosus* Linn., *Chenopodium ambrosioides* Linn., *Cassia tora* Linn., *Mimosa pudica* Linn., and numerous others. The most striking case that has recently attracted my attention is that of *Borreria laevis* (Lam.) Griseb., widely distributed in tropical America, and showing no ap-[635]parent special adaptations for seed dispersal. This was apparently introduced into Java

[14] Ridley, N. H. The Botany of Christmas Island, Jour. Straits Br. Roy. As. Soc., 45: 161-162, 1905.

toward the end of the last century, possibly within the present century. In 1935, having received specimens from all the areas listed below within the preceding few years, I recorded it from Sumatra, Singapore, Java, Jolo (southern Philippines), New Guinea, New Britain, and Samoa,[15] while in 1937 Fosberg[16] recorded it from Fanning Island and Fiji. Truly a remarkable extension of range within a period of two or three decades only.

In many standard works numerous plant species of wide distribution are briefly characterized as "cosmopolitan," "cosmopolitan in the tropics," "all warm countries," "pantropic," etc. Yet in the vast majority of cases the wide species distribution is purely artificial. A surprisingly small number of species are of natural pantropic distribution, and the list is largely confined to those species with very special adaptations for dissemination by floating seeds or fruits. Characteristic of this small group may be mentioned *Canavalia maritima* (Aubl.) Thou., *Ipomoea pes-caprae* (L.) Roth, *Hibiscus tiliaceus* Linn., *Thespesia populnea* Corr., *Entada phaseoloides* (L.) Merr., *Suriana maritima* Linn., *Sesuvium portulacastrum* Linn., *Cassytha filiformis* Linn., *Dodonaea viscosa* Jacq., *Caesalpinia crista* Linn., *C. nuga* Linn., and *Vigna marina* (Burm.) Merr. *Pisonia aculeata* Linn. undoubtedly owes its naturally wide distribution to the fact that the glutinous fruits are disseminated by adhering the feathers of pelagic birds. It is, however, important to realize that the great majority of strand plants having special adaptations for dissemination by means of floating fruits or seeds are frequently of relatively limited distribution, while perhaps widely distributed in the Indo-Malaysian region, or in tropical America, not being able to transcend the limits of the Pacific or the Atlantic oceans. In this category may be mentioned representatives of the genera *Crinum, Hernandia, Pemphis, Erythrina, Cerbera, Nipa, Licuala, Oncosperma, Avicennia, Rhizophora, Bruguiera, Ceriops, Kandelia, Sophora, Triumfetta, Vitex, Terminalia, Lumnitzera, Sonneratia, Osbornia, Aegiceras, Barringtonia, Casuarina, Aegialitis, Camptostemon, Xylocarpus, Colubrina, Clerodendron,* and *Scyphiphora.* Some of the species extend from eastern Africa throughout Malaysia to tropical Australia and western or central Polynesia, but few of them extended to eastern Polynesia, and none reached the American coast, while still others are limited to certain parts of Malaysia.

In contrast to the very limited number of species of natural pantropic distribution, we find today hundreds of species thoroughly established and entirely at home within the tropics of both hemispheres. The wide distribution of these numerous species is due to the agency of man, and the distributional agencies have been active only within the past few hundred years, dating from the period of expansion of the European colonizing nations commencing in the fifteenth century. These now universally distributed species, often dominant in the regions wherein they have been introduced and naturalized, form much of the characteristic vegetation in the settled areas within the tropics of both hemispheres wherever the annual precipitation is sufficient to supply proper moisture needs. They break down into two series, one of American origin, the other of Old World origin. It is

[15] **Merrill, E. D.** Proc. Michigan Acad. Sci., 20:109, 1935 (1934); Gard. Bull. Straits Settlements, 8:132, 1935; Philip. Jour. Sci., 60:34, 1936.

[16] **Fosberg, F. R.** Occ. Pap. Bishop Mus., 13:293, 1937.

interesting to note that the most aggressive and hence the most dominant species of weeds in the Old World tropics are in general those of definite American origin such as *Hyptis suaveolens* Poir., *Cassia tora* Linn., *Mimosa pudica* Linn., *Paspalum conjugatum* Berg., *Heliotropium indicum* Linn., *Waltheria americana* Linn., *Crotalaria* [636] *incana* Linn., *Malvastrum coromandelinum* (Linn.) Garcke, *Ageratum conyzoides* Linn., and such ubiquitous shrubs as *Lantana camara* Linn., *Leucaena glauca* (Linn.), Benth., and *Acacia farnesiana* (Linn.) Willd. Backer speaks of the "Napoleonic ambitions" of various weeds of Brazilian origin in Java. Yet in contrast to these aggressive American species once naturalized in the Old World tropics, we find others of Old World origin that are just as aggressive and dominant in the American tropics, once introduced, as are the foregoing in the Old World, such as *Cynodon dactylon* (Linn.) Pers., *Eleusine indica* Linn., *Eclipta alba* (Linn.) Hassk., *Synedrella nodiflora* (Linn.) Gaertn., and *Bryophyllum pinnatum* (Lam.) Kurz.

There is still a fairly large series of pantropic weeds or weedlike plants, dominant in general wherever they occur, regarding which we can, as yet, scarcely say where they were originally native. This includes a number of grasses and sedges in such genera as *Fimbristylis, Cyperus, Eleocharis, Kyllinga, Sporobolus, Panicum, Paspalum,* etc., as well as representatives of such genera in other families as *Alternanthera, Amaranthus, Euphorbia, Phyllanthus, Sida, Urena, Solanum,* and other groups. Some of the species in such genera as *Fimbristylis, Eleocharis, Cyperus, Paspalum,* and *Sporobolus* may be of natural pantropic distribution, but most of the representatives of other genera in this category are certainly man-distributed no matter where they originated. Doubtless many can eventually be more or less localized with respect to their place of origin, through a critical examination of the early botanical literature appertaining to the tropical floras of both hemispheres. Thus *Cynodon dactylon* (Linn.) Pers., which from the generic distribution alone we might accept as of Old World origin, but which is now cosmopolitan in range, does not appear in the early literature appertaining to tropical America, clear evidence that it is, here, a plant of relatively recent introduction. It seems to be unquestionably of Indo-Malaysian origin.

Returning to the Polynesian problem it is, or should be, manifest that most of the few basic food plants utilized by the original Polynesians for food are of Old World origin. We can only conclude that the migrating Polynesians, entering the Pacific basin from the west in approximately the fifth century A.D., took these plants with them from Malaysia and gradually distributed them from island group to island group all over the Pacific region, where they formed permanent settlements. The species involved include the coconut, banana, sugar cane, taro, yam, gourd, breadfruit, *Alocasia,* and *Cyrtosperma.* It seems possible, however, that the Polynesians, in the course of their voyaging here and there in the Pacific may have reached the west coast of America, for although failing to establish themselves there, it is claimed that they introduced the sweet potato into Polynesia from America.[17] Buck claims that this plant was grown in

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[17] **Dixon, R. B.** The Problem of the Sweet Potato in Polynesia, Am. Anthropol. 34:40-66, 1932; **Buck, P. H.** Vikings of the Sunrise, 1938.

Hawaii in 1250 A.D., and in New Zealand not over 100 years later. The surprising thing, perhaps, is that if the Polynesians did reach America, they did not transmit more edible plants of American origin on their return voyage. One can scarcely accept the early sweet potato introduction as an absolutely established fact. For opposing data see G. Friederici, "Die Süsskartoffel in der Südsee," *Mitt.-Ges. Völkerk.* (Leipzig, 1936), pp. 2-7.

The weed problems of isolated small islands where agriculture is of secondary importance are simple as compared with the weed problems of larger high islands such as Fiji, Samoa, Hawaii, and even Tahiti, and other groups where the population is rather extensive and where agriculture has been widely developed. Within Polynesia the most complex situation today is that [637] of Hawaii, where myriads of species have been introduced and have become thoroughly naturalized in relatively recent times, often within the present century. This situation has been discussed by Rock in some detail. Here, before the advent of man, it seems probable that most of the land area was covered with forests of one type or another, except in regions too dry to support tree growth or where the vegetation may have been destroyed temporarily by lava flows. Rock[18] gives a graphic picture of the present situation as follows: "Between 2,000 and 3,000 feet elevation the forest has disappeared and only stragglers of tree ferns can be found standing, though ten times as many are lying dead on the ground and overgrown with all possible weeds, which the ranchmen have imported with their grass seeds. Among them is the composite climber, *Senecio mikanioides*, an awful pest, which has become well established on Hawaii. At 3,000 feet a few Koa trees can be found, together with Naoi, and here also was found a single native palm, *Pritchardia* sp., windswept and half dead. If one considers the natural condition in which this palm flourishes, as for example in the dense tropical rain forests in Kohala, and then looks at the single plant all alone in a field of *Paspalum conjugatum,* as the accuser of man the destroyer, it stands a witness to the fact that there, surrounding it, was once a beautiful tropical jungle."

Some idea of the extent of introduction and naturalization of species within a single plant family may be gained by examining a recently published work on the range grasses of Hawaii.[19] On pages 125 to 135 are listed about 240 species with the native country indicated and also, if introduced, the date of introduction into Hawaii. Less than 50 of the species listed are actually natives of Hawaii; one, sugar cane (*Saccharum officinarum*), is definitely indicated as an introduction by the early Polynesians; and one other, *Paspalum orbiculare,* is indicated as a probable early introduction. About 180 species have been introduced since the advent of the Europeans in Polynesia. This is in very striking contrast to Brown's unsupported claims of about 80 early Polynesian introductions, in all groups of plants, into southeastern Polynesia, including a certain number definitely known to be of American origin, preceding the period of European exploration in the Pacific basin.

This paper may be briefly summarized as follows: In prehistoric

[18] **Rock, J. F.** The Indigenous Trees of the Hawaiian Islands (1913), p. 25.

[19] **Whitney, L. D., Hosaka, E. Y., and Ripperton, J. C.** Grasses of Hawaiian Ranges, Hawaii Agr. Exp. Sta. Bull., 82:1-148, 1939.

Polynesia, beginning in the fifth century A.D., the islands were occupied by invaders from the west, the ancestors of the present Polynesian race. They replaced a somewhat more primitive, nonagricultural race that had occupied at least some of the islands at a somewhat earlier date, although the latter group had apparently been in Polynesia for only a period of a few hundred years. The Polynesians brought with them from Malaysia the few plant species that they cultivated as a source of food, including the breadfruit, coconut, taro, *Alocasia, Cyrtosperma,* sugar cane, the banana, and certain yams, and the *Lagenaria* gourd. In this period of invasion and expansion they also brought into and spread within Polynesia a limited number of weeds of Indo-Malaysian origin. During the period of exploration of the Pacific Basin they certainly reached the west coast of America, but failed to establish themselves there permanently; but they did introduce into Polynesia one important food plant of American origin, the sweet potato, and spread it from Hawaii to New Zealand in the thirteenth and fourteenth centuries A.D., well before the advent of the Europeans in the Pacific Basin. It may be assumed that at the same time they may have introduced a very few weeds of American origin; [638] but most of the American weeds reached Polynesia after the advent of the European explorers. Most of the present-day Polynesian cultivated plants and weeds, whether of American or of Eurasian origin, have been introduced since the beginning of European exploration in the sixteenth century, and chiefly within the past two centuries. Thus the many hundreds of species of cultivated food plants, economic species, ornamental forms, and weeds, most of them now of more or less universal pantropic distribution, owe their presence in Polynesia directly or indirectly to the plant introduction and dissemination activities of man. Plant introduction, slow and halting in the prehistoric period, gained momentum after the advent of the European explorers in the sixteenth century, and shows an ever-increasing tempo.

Much detailed work remains to be done regarding the early introductions, both in reference to the places of origin of certain now dominant weed species and as to when and how they reached Polynesia. While there is considerable difference in opinion as to what species are of American and what are Indo-Malaysian in origin, the tangible evidence available shows clearly that all of the early cultivated food plants, with the exception of the sweet potato, and most of the now pantropic weeds that occurred in Polynesia before the close of the sixteenth or seventeenth centuries, were of Old World origin.

The investigator must of necessity retain a judicious attitude, critically analyze and evaluate the evidence, and be not unduly influenced by preconceived opinions before accepting this or that published statement as conclusive and final. It seems well to cite here certain types of publications that illustrate this point. If one casually reads certain papers dealing with the supposedly American origin of individual species, one will be impressed by the corroborative data presented, but will be disillusioned if one merely scans the opposing data. It is one thing to present the evidence for and against a certain conclusion, but quite a different thing where only supporting evidence is given and the opposing data overlooked or ignored.

Thus Cook's[20] expressed ideas regarding the origin of such plants as the coconut and *Hibiscus tiliaceus* Linn. become rather fantastic when one realizes that his arguments are largely in support of an apparently preconceived theory, consisting only of facts and assumed facts that support the theory, while the data in opposition are conspicuous by their absence. His conclusions have not only been challenged but thoroughly disproved.

The maho or mahagua, *Hibiscus tiliaceus* Linn., is a species of natural pantropic distribution, its seeds being most ideally adapted to dissemination by ocean currents. The claim was made that this species was native of tropical America and that it owed its occurrence in the Old World to the activities of early man, who introduced it from tropical America into Polynesia and thence to other parts of the Old World tropics. It seems clear that every assumption accepted as evidence in support of this theory, was erroneous.[21]

In the case of the coconut the conclusion was that the species was of American origin, introduced into the Old World by early man, but Beccari[22] and Chiovenda[23] paint the other side of the picture and the latter shows with rea-[639]sonable certainty that this important palm was not only not native of America but that it did not actually occur in America until it was first introduced into Brazil by the Portuguese and somewhat later into Mexico by the Spaniards.

[20] **Cook, O. F.** The Origin and Distribution of the Cocoa Palm, Contr. U. S. Nat. Herb., 7:257-293, 1901; History of the Coconut Palm in America, ibid., 14:271-342, 1910; **Cook, O. F.** and **Cook, R. C.** The Maho or Mahagua as a Trans-Pacific Plant, Jour. Wash. Acad. Sci., 8:153-170, 1918.

[21] **Merrill, E. D.** Comments on Cook's Theory as to the American Origin and Prehistoric Polynesian Distribution of Certain Economic Plants Especially Hibiscus tiliaceus Linn., Philip. Jour. Sci. 17:377-384, 1920.

[22] **Beccari, O.** Origin and Dispersal of Cocos nucifera, Philip. Jour. Sci., 12:27-43, 1917.

[23] **Chiovenda, E.** La culla de Cocco. Contributo alla ricerca della patria originaria della Palma de Cocco, Webbia 5:199-294, 1921; 359-449, 1923.

— XIX —

SOME ECONOMIC ASPECTS OF TAXONOMY*[1]

[50] One dictionary definition of taxonomy is: "Classification; especially classification of animals and plants according to their natural relationships; also the laws and principles of such classification." Another, a bit longer is: "The laws and principles of taxology, or their application to the classifying of objects of natural history; that department of science which treats of classification; the practice of classification according to certain principles." And in this same dictionary taxology, a term I have never wittingly used, and which I shall eschew, is defined as: "The science of arrangement or classification; what is known of taxonomy." Here I infer that the lexicographer responsible for the definition of both taxonomy and taxology may have preferred the latter to the former, but taxonomy, widely and universally used, will scarcely be replaced by taxology, no matter what a lexicographer may prefer.

Under the first definition, including the laws and principles of classification, one could wander far afield and become bogged down in discussions of the laws of nomenclature for nomenclature cannot be disassociated with taxonomy, for we must, of necessity, use names for the objects with which we are concerned. However, I have no intention of thus widening the subject to include problems of nomenclature and interpretations of the rules and regulations set up by international botanical congresses to govern the application of names, for such discussion would be endless.

This topic was assigned to me and is, perhaps, not one that I would have chosen voluntarily. Thus I feel relatively little personal responsibility as to just how I may develop the subject, realizing very fully that no two individuals would treat it in a comparable manner. To limit the definition to "classification according to natural relationships" would be unwise, for in practice, while it is fully realized that arrangement according to natural relationships is the objective that is always desirable, this is not always practicable. Often our reference collections are totally inadequate, and we have to do the best that we can with what is available. The result is that not infrequently we are obliged to utilize characters of a more or less obvious nature, and not always those that indicate the closest natural relationships between various groups, whether these be major or minor categories. Again, we may utilize a combination of obvious utilitarian characters associated with others that clearly indicate natural affinities, in order to attain a certain objective.

As long as the learned world of the early European civilizations up to and [51] including the middle ages knew and utilized only a few hundred basic plant species, botanical science and taxonomy was indeed a simple matter. In those distant days a rough classification, as to major groups, as trees, shrubs, and herbs sufficed. Species were designated by shorter or longer descriptive Greek or Latin sentences. But even in these early days

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* E. D. Merrill, "Some Economic Aspects of Taxonomy" (Torreya 43:50-64, 1943).

[1] Read at the 75th Anniversary Celebration of the Torrey Botanical Club at The New York Botanical Garden, Tuesday, June 23, 1942.

there was, here and there, the beginnings of classification by obvious characters indicating varying degrees of natural relationships. In the Europe of renaissance the pulse quickened. Up to this time those who were at all concerned with plants and their utilization, being scholastically minded, could think only in terms of the ancient Greek and Latin masters. All attempted to refer their plants to those recognized and named by the classical authors, particularly Dioscorides. In northern Europe, with the invention of printing and the general advancement in learning, it became evident that many of the species characteristic of this part of the continent were really different from those of the Mediterranean region. Once this break came with classical traditions, progress was greatly accelerated, as evidenced by the masterful works of Fuchs, Brunfels, Bock, and others, for these pioneers had returned to the actual study of plants as opposed to merely a study of the classics. Following the epoch making discoveries of the pioneer Portuguese and Spanish navigators the small stream of botanical knowledge became a flood.

Still for the most part the cumbersome system of designating species by descriptive sentences prevailed and no radical change was made in nomenclature until 1753, when Linnaeus promulgated his very simple and very obvious binomial system. I say "very simple and very obvious" because it was so simple and so practicable that one constantly wonders why it was not developed as a system some centuries earlier. The idea of the genus had taken root at an earlier date, and following Linnaeus's innovation this radical departure in designating plant species by a *binomial,* a generic and a specific name, quickly prevailed. After all, in common everyday parlance the binomial system of designating plants was widely used among the common people of many countries, but there was a wide gulf between daily usage of the people and the learned world. Witness binomials in the common names of plants, such as white oak, red oak, cork oak, burr oak, live oak, scrub oak, swamp oak, post oak, chestnut oak, valley oak, holm oak, pin oak, water oak, willow oak; stone pine, sugar pine, white pine, red pine, yellow pine, nut pine, Scots pine, Austrian pine, black pine, loblolly pine, jack pine, and digger pine. This system of common names as binomials is not modern, but is one of the most ancient things in many languages, this usage being very widespread in the world at large, and among primitive as well as among culturally advanced peoples.

But coupled with the Linnaean binomial system was his artificial system of classification based essentially on the number of carpels and the number and [52] arrangement of the stamens. This was a very *practicable* system for arranging genera as a matter of convenience and it dominated the field for somewhat longer than the succeeding half century, although by the end of the eighteenth century the handwriting was on the wall, and in the early part of the nineteenth century the artificial system was generally replaced by the natural system of classification with which we are familiar.

If the proposal of the binomial system by Linnaeus raised a mild storm among those accustomed to the earlier much more cumbersome system of nomenclature then in vogue, a storm that quickly subsided leaving the binomial system universally established and accepted, the proposition to arrange the genera in natural families raised a veritable hurricane among the

devotees of botany accustomed to the simple and convenient Linnaean system. This storm raged for some decades and we of the present age have little conception of it.

In 1831, John Torrey published his American edition of Lindley's "Introduction to the Natural System of Botany." He states in advertisement: "In France, the natural or philosophical method has for many years past taken the place of the artificial sexual system of Linnaeus, and recently by the labours of Brown, Lindley, Hooker, Greville, and others, it has begun to be employed in England and Scotland. . . . . I at once perceived that a desideratum in British and American botany, long felt and lamented, was at length supplied. It therefore occurred to me that I could not do a more acceptable service to the friends and cultivators of Botanical Science in the United States, than by preparing an American edition for the press forthwith. . . . . This is an epitome of modern philosophical Botany, and will be found highly useful to those who wish to obtain an accurate knowledge of the Natural Classification of the Vegetable Kingdom."

At this time all botanists in the United States, with the exception of Rafinesque, were professed Linnaeists; there was no other system of classification as far as they were concerned. What happened? Consider Amos Eaton's statement of 1833.[1] In speaking of Torrey's edition of Lindley he wrote:

"Since Dr. Faustus first exhibited his printed bibles in the year 1463, no book, probably, has excited such consternation and dismay as Dr. Torrey's edition of Lindley's Introduction to the Natural System of Botany. And to make the horrors of students, as well as of ordinary teachers still more appalling, Dr. Torrey's Catalogue of American Plants at the end of his Lindley, was so singularly presented, that it would seem to indicate an awful catastrophe to all previous learning. To relieve all concerned, let me make this pledge: Nothing new is presented either in the text or in the catalogue [*i.e.*, Eaton's own Manual], excepting what ought to have been discovered in this *progressive* science, since the fifth edition of this Manual was printed; and [53] not much *real improvement* has been added, as between the fourth and fifth editions. . . . . As far as I have any influence I pledge it here, that the embarrassing innovations of De Candolle and others are *no possible use* to the science of Botany. . . . . An attempt is made in his Lindley to prove that the Artificial method of Linnaeus is unnecessary. In doing this he proposes an *Artificial Method*[2] of eleven pages. As those who have not read Torrey's Lindley will scarcely believe this unaccountable absurdity, they are requested to examine, unbiased, that work between pages lxvi and lxxx of the introduction. This artificial system [artificial key to

[1] **Eaton, A.** Manual of Botany for North America, ed. 6, i-vi. 1833.

[2] Eaton apparently wrote this very hurriedly, for this statement regarding an artificial method is an error. What is presented is an *artificial analysis* of the orders in the form of a key to the classes (Vasculares, Cellulares), subclasses (Exogenae or dicotyledonous plants, and Endogenae or monocotyledonous plants), tribes (Angiospermae, Gymnospermae, Petaloideae and Glumaceae), and to the families under each division and subdivision, these, as to limits (but naturally not as to sequence as at present understood) much the same as they stand today. Torrey's "singularly presented" catalogue is merely an arrangement of the genera of North American plants by families under the natural system!

families] is said to lead to the Natural Method. . . . . The improvements upon Linnaeus, which have been made, do not authorize any change in the science of Botany other than mere additions and corrections. . . . ."

This caustic critique of the natural system of classification is eliminated from the seventh (1836) and eighth (1840) editions of Eaton's "Manual," and in these, although he adhered to the Linnaean artificial system of classification, he so far relented as to include an epitome of the natural system. If, however, one needs a good illustration of a closed mind, here we have it, and this statement is made in all due regard to Eaton's remarkable accomplishments[3] although it is only fair to explain that in botany Eaton never claimed originality. He states[4] that in the field of botany he never aspired to be anything above that of a *teacher, translator,* and *compiler.* It should be noted that Eaton italicized his characterization of botany as a *progressive* science, yet at the same time insisted that the suggested improvements on the Linnaean system did not authorize any changes in the science of botany other than mere additions and corrections! This is an ultra-conservative, nay, even a reactionary attitude.

McAllister, p. 235, quotes from John Torrey's letter of November 2, 1833, to L. D. von Schweinitz giving his reaction to edition 6 of Eaton's "Manual": "This time Torrey was *more effusive* (italics mine) in his praise of the *Manual* when he wrote to his friend De Schweinitz 'Have you seen the 6th edn. of Eaton's Manual of Botany? . . . . . I began to read the preface in a bookstore the other day & it seemed to be a most remarkable performance.' " In view of the circumstances one wonders if the term "effusive" is the correct one for in [54] the same letter Torrey also says[5] that he had scarcely seen more than the covers of the book and that he was interrupted before he had finished the first page; and this first page begins with Eaton's castigation of Torrey, my quoted passage: "Since Dr. Faustus first exhibited his printed bibles in the year 1463, no book has, probably, excited such consternation and dismay as Dr. Torrey's edition of Lindley's Introduction to the Natural System of Botany." I am afraid that the dear lady didn't read this preface, for under the circumstances Torrey's statement to De Schweinitz can only be interpreted as sarcastic and ironic, as far as a gentle soul like John Torrey could be ironic and sarcastic, certainly not as "effusive" praise! The relationships between Eaton and Torrey had their ups and downs. Clearly we do not have to confine our reading to the opinions of modern botanists to learn just how certain individuals judge their contemporaries, for throughout botanical history individuals have not hesitated to say just what they thought about the work of this or that author. In the constant quibbles that one notes in taxonomic literature one is reminded of a remark ascribed to President Lowell when some acute problem regarding the interrelationships of certain prima donnas among Harvard botanists needed to be settled: "What is it about the pretty little flowers that makes the botanists quarrel so much among themselves?"

Within a decade or two from the time that Eaton castigated Torrey for

[3] **McAllister, Ethel M.** Amos Eaton. Scientist and Educator, i-xiii, 1-587, illus. 1941.

[4] Manual. ed. 7. iv. 1936.

[5] Mem. Torr. Bot. Club **16**: 280. 1921.

his progressiveness, the Linnaean system of classification was entirely outmoded and abandoned, and was replaced by the natural system that he so violently condemned. Eaton, the non-progressive botanist is, as a botanist, only a vague memory among the devotees of this science today. But Torrey, who was the subject of his scorn, forged steadily ahead to become the outstanding American botanist of his time; and this organization, the Torrey Botanical Club, the oldest botanical association in America, today celebrating the seventy-fifth anniversary of its establishment, honors John Torrey's name, and its founders incidentally honored the organization itself, in the selection of its name, a perpetual reminder of the services rendered by this outstanding individual and botanist. Had Torrey been another Eaton, clearly there never would have been a Torrey Botanical Club.

Because of the vast number of organisms that the naturalist must deal with as to species, to say nothing of higher categories such as genera and families, it is clear that it is impossible to arrange large groups *in any lineal arrangement* that will show all natural relationships. This is particularly true of the major groups. We may follow the Bentham and Hooker system for convenience, treating in sequence first the dicotyledonous plants, then the gymnosperms, and then the monocotyledonous groups, although this is a very unnatural arrangement because the gymnosperms are infinitely more primitive, among the flow-[55]ering plants, than the dicotyledons and the monocotyledons. Or we may select to follow the Endlicher system as developed by Engler and Prantl, treating the gymnosperms first, then the monocotyledons and finally the dicotyledons; or we may decide with Wettstein and others, that the dicotyledons should be placed before the monocotyledons if the system is to be a natural one, in accordance with various lines of evidence as to the comparative times of development of these last two groups.

It is inevitable that when a proposed system becomes very widely used, like that of Bentham and Hooker, or that of Engler and Prantl, it will become more or less fixed, partly from the weight of authority, partly because of convenience and for comparative purposes. We may all realize that the Engler and Prantl system of arranging families, in some respects is far from a *natural* one, and that radical changes are indicated, particularly in reference to the position, in sequence, of such families as the Magnoliaceae, Ranunculaceae, Berberidaceae, etc., which seem clearly to be much more *primitive* than the Amentales, for example. System after system may be proposed, but relatively few of these will, from the very nature of things, become widely accepted as to the sequence of arrangement of major groups, partly from inertia on the part of working botanists, partly because it is always desirable to be able to make direct comparisons with the work of others, and partly because one is never sure as to just when some morphologist may discover evidence that upsets all previously proposed systems and sets up another "improved" one. It all comes down to the simple fact that within the plant kingdom, when one is dealing with such groups as natural families, it is impossible to make any *lineal* arrangement that will show all relationships and inter-relationships, for development and differentation has not followed a straight line from

a lower to a higher group, but in many cases it has been divergent, and, we may suspect, reversions have played their part. To indicate natural relationships we must construct variously branched "trees" to show origins and relationships as well as historical sequences; but in a book we must hew pretty closely to the straight line, whether we are dealing with a series of families in a system of classification, or whether we are dealing in terms of a simple manual for field use, for one page follows another from beginning to end.

Again, we must always keep in mind that the objects with which we are dealing are variable; that our accumulated knowledge constantly increases; that a system that we might set up today, on the basis of the available data, may be outmoded a few years hence when more comprehensive collections, and when a more intensive study of obscure details, perhaps supplemented by anatomic, cytogenic, genetic, historic, and geographical data, become available. This comment applies more to the problem of species and their interrelationships than it does to larger categories such as genera and families. All [56] active systematists are familiar with these factors from their own daily work. As examples, I may cite my own experience. In 1904, I hopefully prepared a key to the 21 then known Philippine species of *Medinilla,* not realizing what changes would be necessary within a few years, for less than twenty years later, about 125 species of this genus had been described from or accredited to the Philippines. In 1900 there were actually known from the Philippines only 13 species of the Pandanaceae, *Freycinetia* with 7 species, and *Pandanus* with 6, of which only one was definitely understood and could be placed in reference to other described species of this genus, five described by Blanco appearing in all botanical literature as *species ignotae* or *species dubiae.* Twenty-five years later not only had all of Blanco's "unknown" species been placed, but the total for the family stood at 93 species, *Freycinetia* 45, *Pandanus* 47, and *Sararanga* 1. This is what has happened in family after family and genus after genus within the present century as comprehensive collections have been assembled from the botanically little known parts of the world such as China, the Philippines, Malaysia outside of Java and to a certain degree the Malay Peninsula, Siam, Indo-China, tropical Africa and tropical America. What is the reaction of local taxonomists, working on a restricted flora, the constituent elements of which are well known, in reference to such a work as that of Schlechter[6] in which no less than 1153 new species of orchids are described in one work, and these all from German New Guinea? The area of German New Guinea is 68,500 square miles, and for comparison that of New York State is slightly less than 50,000 square miles. Incidentally, approximately 2500 new species of orchids have been described from the Island of New Guinea since 1900. These cited examples merely represent a few that demonstrate the acceleration of what happened within the present century as various parts of the world were opened up to botanical exploration. What happened in various parts of the world happened in the United States when the West was opened up by exploration, and still later when a respectable body of local botanists developed in the

[6] **Schlechter, R. Die Orchideen von Deutsch-Neu-Guinea. Repert. Sp. Nov. Beih. 1: i-lxvi. 1-1079. 1911-14.**

West. This is, in part, the basis of the break between Asa Gray and E. L. Greene, for Greene was on the ground and was intimately acquainted with the local flora of California; I say "in part" because there was also an entirely different concept between the two as to what constituted a species.

It will be a long time yet, at our present rate of progress—which may be greatly slowed down in the coming years—before the imperfectly known regions mentioned above may be considered to be even reasonably well explored. Until this end is attained all treatments of all large groups that have representatives growing in these vast and only partly explored areas can [57] be considered only as tentative. We do the best that we can with what we have at hand, and optimistically hope for the best. One closing example. In 1800, about 65 species of *Ficus* were more or less definitely known from the entire world. In 1801 Willdenow[7] described four new species and rather naïvely remarked: "Je ne doute pas que dans les climats chauds il n'existe encore plusieurs espèces de figuiers encore inconnues," little realizing that before the year 1940, a total of approximately 2,400 binomials would actually be proposed in this Brogningnagian genus—God forbid that these 2,400 binomials represent 2,400 distinct species, but the number of valid ones is very great, certainly approaching 2,000, even without splitting hairs on specific differences. If any taxonomist is looking for new worlds to conquer, I recommend that he undertake a monographic treatment of this vast assemblage.

In citing the above examples of the rapid increase in the numbers of proposed species in certain genera, far be it for me even to suggest that the actual naming and describing of new species is an end in itself, or if there is anything difficult about the art. As a matter of fact it is a very easy and simple matter to name and describe a species *as new;* it isn't so easy to determine whether or not the particular form in hand has been named and described by some earlier botanist or whether it actually constitutes a sufficiently distinct entity to be considered worthy of consideration as a species; to say nothing about macrospecies or microspecies, nor even to mention subspecies, variety, subvariety, form, proles, or any other category that has been suggested, but never too well defined, to indicate minor entities. With the myriads of forms with which we must deal we must have names. The competent monographer follows and either embalms our possible error by recognizing a species as valid, or sinks it into synonymy; and if the latter happens then at some future date some other monographer may reinstate it with the chances that in the interim some other optimistic taxonomist may have renamed and redescribed the same form under a new name in his confidence that a published reduction is always a reduction, which, perhaps unfortunately, is not always the case.

The special properties of a very high percentage of our thousands of species of economic plants, whether utilized for food, for medicine, for fibers or for any other purposes were originally discovered by empirical processes and by observation rather than by direct and deliberate investigations. This is the history of most plant species of economic importance

[7] **Willdenow, C. L.** Détermination de quelques nouvelles espèces de Figuier, et observations générales sur ce genre. Mem. Acad. Sci. [Berlin] **1801: 91-104.** *t. 2-5.* **1801.**

whether it be the lowly bean used for food, or the insignificant looking *Ephedra sinica* now extensively utilized in the practice of medicine. Although this *Ephedra* has been utilized by the Chinese for many centuries it is only within the present century that it was definitely demonstrated that its curative principle ephedrine is really of [58] distinct value in the treatment of asthma and various diseases of the nasal passages. Through taxonomy, however, a realization of the relationships of plants, we find what may be an important lead. If *Ephedra sinica* yields ephedrine, isn't it possible or even probable that other species of the same genus may yield the same curative agent? Thus a pharmacological investigation of all species of *Ephedra* might be indicated, for the sole natural source of *Ephedra sinica* is northern China, although other species of the genus occur in various parts of Asia, Europe, and North America. It is admitted, now that ephedrine has been synthesized, that further work on representatives of this particular genus may scarcely be worthwhile, but the case serves to illustrate the problem of botanical analogy.

Take the case of chaulmoogra oil, now extensively and successfully used in the treatment of leprosy. For centuries this oil was used in India for the treatment of leprosy and various skin diseases. For nearly a hundred years the situation was confused because the plant named by Roxburgh as *Chaulmoogra odorata* Roxb., but never actually described by him, was supposed to be the species that yielded the effective drug; yet the seeds of Roxburgh's species, later described as *Gynocardia odorata* R. Br., when investigated, were shown to contain no active curative principle. It was not until 1900 that Sir George Watt cleared up the confusion and determined the botanical source of the true chaulmoogra seeds as *Taraktogenos Kurzii* King = *Hydnocarpus Kurzii* Warb. Rock,[8] who has discussed this subject, states that it is quite probable that not only seeds of this species but also those of *H. castaneus* Hook. f. & Th. and other species of *Taraktogenos* and *Hydnocarpus,* as yet undescribed, are sources of the chaulmoogra oil of commerce. The botanical confusion that prevailed for a hundred years unquestionably retarded a critical and serious investigation of chaulmoogra oil as a remedy for leprosy. It is only within the present century that this cure has come into its own.

Intrigued by the problem of analogy and suspecting that the seeds of some of the Philippine species of *Hydnocarpus* might contain the same curative principles as the true chaulmoogra oil, I was instrumental in fostering an investigation of those Philippine species that were available, including *Hydnocarpus Alcalae* C. DC., *H. subfalcata* Merr., *H. Woodii* Merr., and *H. Hutchinsonii* Merr. Various studies were made in the Bureau of Science culminating in 1928, when Messrs. Perkins and Cruz[9] investigated the oils of ten species including four from the Philippines and Borneo, and found that in these four species the oil was very similar in chemical composition to commercial chaul-[59]moogra oil except that *Hydnocarpus*

[8] **Rock, J. F. The Chaulmoogra tree and some related species: A survey conducted in Siam, Burma, Assam, and Bengal. U. S. Dept. Agr. Bull. 1057: 1-29.** *t. 1-16.* **1922.**

[9] **Perkins, G. A. and Cruz, A. O. A comparative analytical study of various oils in the chaulmoogra group. Philip. Jour. Sci. 23: 543-569.** *t. 1.* **1928.**

Alcalae C. DC. contains a very large amount of chaulmoogric acid and little or no hydnocarpic acid. The total percentage of oil varied from a minimum of 11 percent to a maximum of 39 percent. Now as far as known none of the Philippine and Bornean species was utilized for any purposes by the native population. They were, of course, unknown to the small technical public outside of the very few botanists, and it is an interesting commentary to note that as to the Bornean *Hydnocarpus Woodii* Merr. trees were actually found to be growing within the limits of the leper colony on Sandakan Harbor; a remedy actually at hand, but previously unknown, and its potentialities hence unrealized.

In the latest treatment of this group[10] *Taraktogenos* Kurz is reduced to *Hydnocarpus* Gaertn. and a total of forty species are recognized. Not more than one-fourth of these species have been investigated from a pharmaceutical standpoint; and yet from what is known of the properties of those that have been investigated it is safe to assume that the seeds of most of the species of the genus will be found to yield the same curative principles as are found in the true chaulmoogra oil.

Thus from analogy, working from a Burmese species, the curative principles in its seeds being known, investigations extend to the seeds of the Philippine and Bornean species of the same genus, *Hydnocarpus,* with potentially important economic results. These examples will suffice to demonstrate what has been done in special cases, and by analogy we may expect that in the future similar investigations will be extended to very many species that have hitherto never been considered as even worthy of investigation; but in a reasonable percentage of cases we may definitely assume that these species, as yet unknown and unappreciated from an economic standpoint, will be shown to produce needed and otherwise unattainable products. Here the tempo increases under the pressure of necessity brought about by war conditions in reference to supplies of rubber, quinine, and various other products for which, in the past, we have depended largely on Asia and Malaysia for our supply; and our economy and even way of life was increasingly geared to various imported basic products which now are unobtainable elsewhere. Now new sources must be developed, if not from the same species so successfully developed in the specialized agriculture of certain parts of the Old World (even although in some cases based on native American plants, such as *Hevea* and *Cinchona*), then from others that yield similar products. It is in this specialized field of potential substitute plants that may yield important products that we now lack, that the trained and experienced taxonomist can render, and is rendering, fundamentally [60] basic services. It is this type of individual who knows his plants and who knows plant relationships who can serve to great advantage, for his accumulated store of special knowledge cannot be matched by those botanists trained and experienced in other fields remote from that of taxonomy and systematic botany. Let us hope that those charged with selection for super-specialized services such as those indicated in this field of botanical analogy, will select wisely and well. After all there is much

[10] **Sleumer, H.** Monographie der Gattung *Hydnocarpus* Gaertner nebst Beschreibung und Anatomie der Früchte und Samen ihrer pharmakognostisch wichtigen Arten (Chaulmugra). Bot. Jahrb. *69*: 1-94. *t. 1-4.* 1938.

truth in the popular conception of what a botanist is—an individual who knows and can name plants; yet the vastly higher percentage of our professional botanists have almost no knowledge and less experience in this specialized field of taxonomy, and many of them have no interest in it. They are for the most part specialists in totally different branches under the all-inclusive term botany, for in our times the term botanist covers not only the taxonomist and systematist, but also the fields of morphology, physiology, ecology, cyto-genetics, cytology, histology and various other subdivisions; the numerous devotees to these subdivisions of botany are all "botanists" in spite of the popular definition cited above. A very high percentage of them would be utterly lost were they to be assigned to special problems in this distinctly complicated field of botanical analogy.

Within the field of medicine or pharmacology, here is a simple illustrative case. The European *Digitalis purpurea* Linn. is the source of an important drug, digitalin, and we have generally depended on Europe for our supply. With these supplies now cut off by the war, local sources must be developed. I have no idea of how extensively the plant is now cultivated in the northern United States, but Fernald, on the basis of his own extensive field knowledge, calls attention to the fact that the species is not only thoroughly established in certain parts of Newfoundland, but that in places it is dominant and a veritable pest; a source of supply that only needs to be tapped if there be need to build up our dwindling stocks, and an indication that certain parts of Newfoundland are ideally adapted to the actual cultivation of the species on a large scale if this be needed.

It is clear to all taxonomists and all systematic botanists, that in spite of the imperfections in our current system of naming and describing plant species, and in spite of the distinctly Rafinesquian character of the work of certain individual botanists who can see differences where tangible differences scarcely exist, that taxonomy and the accurate identification of plants is basic to a proper understanding of myriads of problems in the general field of economic botany, pharmacology, agriculture, plant breeding, plant pathology, genetics, forestry, morphology, physiology, and many other fields into which plant science or botany *sensu latiore* has been subdivided. We have little patience with the investigator, no matter what his problem may be, who ignores this basic problem of accurate identification of the material with which he [61] deals. Obviously if one deals with misidentified material his findings may prove to be valueless, for future investigators will find it difficult if not impossible to check his results. There are too many errors in botanical literature due to this lack of critical consideration of this simple basic problem, and much time, and some space in our technical periodicals, has been wasted due to the ignorance or the blind faith of investigators, or those who have stimulated research on a particular subject, who have not considered it to be either essential or even worthwhile to check, or to have some competent taxonomist check, the identity of the plant utilized to prove this or that conclusion. Here is a horrible example:

In 1902 there was published in one of our leading botanical magazines a paper on the morphology of the flower and embryo of *Spiraea* that admirably illustrates the importance of accurate identification. The investigator worked with material representing a single species, the plant widely known

among horticulturists under the erroneous name of *"Spiraea japonica."* Far from being a representative of *Spiraea* or even of the family Rosaceae this plant is *Astilbe japonica* A. Gray of the Saxifragaceae. The author completed his detailed study without even suspecting that he was dealing with a misidentified plant, from which we may assume that he could not have done much bibliographic research as the differences between *Astilbe* and *Spiraea* are remarkable. Is this blind faith in a labelled growing specimen or sheer carelessness or ignorance on the part of those who suggested and supervised the work and thus victimized an innocent graduate student who had faith in the knowledge of his preceptors? The net result was to discredit the student, for about all he got out of it was some training and experience in laboratory technique, discredit to the periodical in which the article appeared, and, may we hope, some discredit on those who sponsored the investigation. It is a classical example of how not to elucidate a morphological problem, for the net result merely served to stimulate the glee of the lowly taxonomists who, as a group, are thoroughly satiated with the "holier than thou" attitude of some of their colleagues in the laboratory aspects of botany. I am much less charitable than was Rehder who called attention to the error.

What do we taxonomists think, when we observe in a physiological paper a tabulation of species whose seeds will not germinate until after they are subjected to freezing temperatures and note the strictly tropical *Carica Papaya* listed in this category? True, pawpaw and papaya are common names of *Carica Papaya* but pawpaw is also the common name of our entirely different northern *Asimina triloba* Dun. We can only assume that the seeds of *Asimina* were what this investigator had, for *Carica* is a plant entirely intolerant to freezing conditions. All of which merely illustrates that we should not put our trust wholly in the currently used common names of plants. After all, "What is [62] in a name, a rose by any other name would smell as sweet" but in cases like these, one is reminded of an expression used by one of the characters in that intriguing comedy, "You can't take it with you" when he was expressing his opinion of the dancing ability of another character in the play.

In this part of the discussion I am rapidly approaching a category recently discussed in the daily press. Under date of May 18, it is reported from Raleigh, North Carolina, that some years ago the Daughters of the American Revolution planted, with elaborate ceremony, a little tree purported to be an offspring of the "Continental Elm" at Cambridge, Massachusetts, under which George Washington is supposed to have taken command of the Continental Army in 1775. They even kept a box of earth taken from around the roots of the parent tree for use in christening the "elm" when it grew up. The little "elm" has grown up and is now blooming; but it is a cherry tree and not an elm at all. Assuming that the young tree that was planted was provided by some nurseryman this merely proves that nurserymen and horticulturists can make mistakes just as botanists do, but is this any reason why a botanist making a really serious study of a plant problem should accept without question as to its correctness, a commonly used but erroneous horticultural name, or should determine what binomial he should use merely by looking up a common name?

One closing example, that of the investigator who had laboriously dug up and intensively studied the root tips of *Tilia* in one of our large collections, and could not understand the discrepancies between the chromosome counts of the root tips and of the branchlets taken from the same trees in a number of cases. It was only after the study had been completed, but fortunately not published, that he learned that many of these species of *Tilia* were grafted, the roots representing an entirely different species from the growing tree. Thus for certain types of investigations we cannot even trust the living plants without knowing something about their history.

I have above referred to the fact that during the many centuries Europe was dependent on its own economy, its inhabitants utilized only a relatively few plant species; a few hundred important ones at most. As various parts of the world were opened up within the few centuries following the expansion of the European colonizing nations the number of species utilized rapidly increased; and this tempo of increase continues unabated. In 1853, Linnaeus recognized 5,950 species of plants in all groups for the entire world, while he and his immediate followers estimated that there might be as many as 10,000 species of plants, in all groups, in the world. The estimate had been increased to 30,000 known species by 1820, and 50,000 indicated as probable for the entire world. By the middle of the century the estimate of known species was 93,000.

Within the present century about 265,000 new binomials have been pub-[63]lished for the flowering plants and vascular cryptogams alone, of which about 194,000 represent hopefully proposed new species, the remainder shuffles or transfers from one generic name to another. The yearly average for the higher groups alone is now approximately 6,500 *as new binomials,* of which about 4,750 represent proposed new species. This is the record of the twentieth century to date. The total number of binomials published from 1753 to 1942 is in the neighborhood of 750,000 for the higher groups of plants alone, and to this must be added those published for the cellular cryptogams; our grand total should be in excess of 1,000,000.

As to the total number of distinct and more or less "known" species, who shall say? Jones has briefly discussed this matter[11] calling attention to the remarkable discrepancies that occur in recent texts, with a spread in the estimates of from 133,000 (Uphof's estimate of 1910) to 175,000 for the angiosperms alone, and concludes that the total for all known groups is in the neighborhood of 335,000. Because of various complications that it is unnecessary to discuss here, I suppose that we may conclude that one guess is as good as another; but knowing something about synonymy; something about the limiting factors in the geographic distribution of individual species; something about more or less universally distributed species; something about the extraordinary richness of tropical floras; something about the remarkable local endemism in various tropical areas; something about the high percentage of novelties that are found in all new collections from hitherto inadequately explored areas; something about those regions that, within the past four decades, have been particularly rich in the crop of new species—my guess is pretty close to that of Jones, and that the total number of reasonably valid described species in all groups is well in excess

[11] Jones, G. Science II. 84: 243. 1941.

of 300,000. Even if the number of valid species should be only half this total, what scientist, no matter what his field, would even have the temerity to suggest that we can get along without taxonomy and nomenclature?

In this discussion I have deliberately been discursive rather than specific. One could cite case after case of the applications of taxonomy to various scientific and economic problems, but a few will serve to bring out the points at issue. Besides those mentioned above in my discussion of botanical analogies we may list the problem of the *Citrus* relatives; the case of *Coffea arabica* Linn. versus *Hemileia vastatrix* Berk.; *Berberis* versus wheat rust; the *Pinus-Ribes* complex in reference to the blister rust of the white pines; the little problem of special strains in such lowly organisms as the yeasts and the fungi when these organisms are basic to certain industrial processes—the list would be unending, for no agricultural crop exists in which problems of plant breeding, of protection against fungus diseases and insect pests do not exist. Many prob-[64]lems have been solved, but many more are still with us, and new ones develop from year to year. With all due regard to the qualifications and accomplishments of the specialists in the various fields concerned, I maintain that the better equipped the investigator is in basic taxonomic knowledge, the better is he fitted to work on his special problems. This does not mean that all botanists should be taxonomists, but it does mean that all specialists and all laboratory botanists should realize the importance of accurate identification, the implication of botanical analogies, and that they should appreciate the facilities outside of their own fields that are available in specialized institutions in various parts of the country. We will go much further with reasonable cooperation than we will by maintaining a pigeon-hole type of specialization.

There should be no real antagonisms between the devotees of various aspects of botanical science, for the inter-relationships are close—much closer than some of our specialists realize. We are all laborers in the same vineyard, and our objective is progress; progress in pure science as well as in the economic aspects of the subject as a whole. To those representatives of the laboratory school of botany who are hypercritical regarding taxonomists and systematists, I would call attention to the fact that progressive taxonomists are now taking advantage of the findings of their associates in other fields including the histologists, pollen experts, geneticists, cytologists, ecologists, and entirely outside of the biological field invoking the aid of geologists, hydrographers, geographers and others in their attempt to solve certain problems of plant relationships.

This very organization that this week celebrates the seventy-fifth anniversary of its establishment was founded by individuals whose fields of interest were essentially field botany, taxonomy and systematics. It has evolved, during the course of years into a national organization and has wisely and progressively widened its activities, yet the unifying idea that maintains it is still that of its founders who were interested in plants and who knew plants as they grew in nature rather than merely as laboratory subjects. I repeat what I have written before: "It has been fashionable in some quarters in modern times to decry both the importance and the value of systematic botany. Because of its vitality, its human interest, its practical bearing on other phases of plant science, and on our everyday life, one

suspects that some of its critics have lacked the breadth of view of leaders in science, and have been misguided in criticizing that which they did not fully understand."

Let us take the broader view, live and let live, keep our respective houses in order, avoid egregious blunders, and attain a realization of the fact that after all there is a unity in plant science in spite of its diversity, and that the entire field is interlaced with the binding bonds of system and order; and this is taxonomy.

RAFINESQUE'S PUBLICATIONS FROM THE STANDPOINT OF WORLD BOTANY*

[110] In undertaking work on a major task of actually preparing a comprehensive "Index Rafinesquianus," I recently had occasion to make a critical examination of all of that most erratic botanist's numerous botanical publications. At the same time I examined a great many papers by various authors commenting on diverse phases of Rafinesque's work. One statement by Professor M. L. Fernald[1] impressed me, and it was his comment that suggested to me the topic discussed in this paper. He had occasion to consider the status of certain eastern North American species named and described by Rafinesque, and states: "Constantine Samuel Rafinesque [Schmaltz], the most erratic student of the higher plants, has made unending trouble for American and (although they apparently do not realize it) European botanists." In another paper on Rafinesque[2] I mentioned Fernald's statement and amplified it by calling attention to the fact that, in his papers published while he was a resident of Palermo, between 1806 and 1815, and especially in his later publications, chiefly those issued in Philadelphia in the decade between 1830 and 1840, Rafinesque originated myriads of problems not only for the students of the flora of Europe to solve, but also for those concerned with a study of the floras of Mexico and Central America, the West Indies, South America, Japan, Siberia, China, India, Central Asia, Asia Minor, Malaysia, Australia, and North, Central, and South Africa. There is scarcely a major floristic area in the world that Rafinesque's work does not touch. His erratic work, in the past largely associated with North American botany, because much of his productive career was spent in the United States, and much of his work was published here, far from raising merely problems of concern to botanists working on the North American flora, actually impinges on world botany to a remarkable degree.

This short paper is not intended to be a summary of Rafinesque's life and work. Briefly he was born in Galata, a suburb of Constantinople, in 1783 and passed his youth in Turkey, Livorno, Marseilles, Pisa, and Genoa. His father was a French merchant, and his mother, née Schmaltz, was of German parentage, born in Greece. He was largely self-educated, never having attended a university. From 1802 to 1805 he lived in Philadelphia, and from 1806 to 1815 in Palermo, Sicily. He returned to the United States in 1815, spending the remaining years of his life in this country. His second voyage to the United States ended in a catastrophe. After a long trip of 100 days, the ship, the *Union of Malta,* on which he was a passenger was wrecked on Race Rocks, near Fisher's Island in Long Island Sound, on November 2, 1815. In this shipwreck Rafinesque states that he lost his fortune, his share of the ship's cargo, all of his natural history collections

* E. D. Merrill, "Rafinesque's Publications from the Standpoint of World Botany" (Proceedings of the American Philosophical Society 87:110-119, 1943).

[1] **Fernald, M. L.** Some genera and species of Rafinesque. Rhodora 34: 21-28, 1932.

[2] **Merrill, E. D.** A generally overlooked Rafinesque paper. Proc. Am. Philos. Soc. 86 (1): 72-90, 1942.

assembled in the preceding twenty years, his library, unpublished manuscripts, drawings, and even his clothes. He remained in New York for several years and in 1818 made his first trip to Kentucky, returning to Philadelphia late in that year. In May, 1819, he left Philadelphia for Lexington, Kentucky, where from that year until 1826 he taught in Transylvania University. He returned to Philadelphia in September, 1826, and with the exception of various exploring expeditions to some of the Eastern States, he resided in that city until his death, September 18, 1840. At the time of his death he was in very straightened circumstances, and his body was buried by some of his friends in Ronaldson's cemetery in that city. The grave was not permanently marked until 1919. His effects were disposed of at auction to meet the demands of his creditors. When Ronaldson's cemetery was abandoned as a cemetery and turned into a city park, Rafinesque's remains were disinterred and removed to Transylvania College, Lexington, Kentucky, in March, 1924. The centenary of his death was celebrated by special ceremonies at Transylvania College in October, 1940.

[111] I cannot refrain from quoting a few passages from G. Browne Goode's[3] review of Richard E. Call's *Life and Writings of Constantine Samuel Rafinesque*. Goode states that Rafinesque was

> a man whose brilliant intellect, eccentric character and unhappy fate will always cause his career to be looked upon with interest, and whose nervous and appalling industry has been the cause of a myriad of perplexities to students of the nomenclature of plants and animals in Europe as well as in America. . . . The roving habit of mind which soon became a part of his nature led him into a mental vagabondage that influenced his career even more than the lack of a permanent place of abode. . . . His precocious mind, unguided and undisciplined, wandered at will over the entire field of books and nature, and by the time he had reached the age of nineteen he had formed his own character and equipped himself for the career which lay before him. . . . Lacking . . . guidance, however, he was by no means fitted to enter upon a scientific career in a country like the United States, so when . . . he crossed the Atlantic [first in 1802, and again in 1815] he brought with him the germs of failure and bitter disappointment. . . . His fatal tendency to 'scatter' was already apparent, and in the work which he did for the 'Specchio' [during his residence in Palermo] all the weaknesses of his subsequent career were foreshadowed.

My adventures in Rafinesquiana commenced in the early part of 1942, when I discovered by chance that in a paper published by Rafinesque[4] in France in 1834 there were no less than 46 new generic names and binomials, for the most part validly published, that had entirely escaped the attention of the compilers of our standard indices. The oversight is scarcely surprising, for the reason that all of these new names are undifferentiated in the text covering Rafinesque's cursory remarks regarding de Candolle's interpretations of certain North American genera and species. Where he differed from de Candolle on problems of nomenclature, he proposed new names in a most casual manner, quite as he did in his earlier reviews of the work of his contemporaries who were then publishing on the flora of North America, including Michaux, Nuttall, Barton, Bigelow, Muhlenberg, Eaton,

[3] Science n.s. **1**: 384-387, 1895.

[4] **Rafinesque, C. S.** Remarques botaniques sur quelques plantes de l'Amérique Septentrionale, dans les quatre premiers volumes du *Prodromus* ou *Synopsis plantarum* de de Candolle. Act. Soc. Linn. Bordeaux **6**: 261-269, 1834. See **Merrill, E. D.**, A generally overlooked Rafinesque paper. Proc. Am. Philos. Soc. **86** (1): 72-90, 1942.

Torrey, Elliott, and Pursh, besides drawing certain conclusions as to the work of Loudon, Lindley, Sowerby, Hooker, and others. It is fortunate, for those who must concern themselves with bibliographical matters in listing new names, that Rafinesque's innovation in publishing many scores of new generic and specific names in his reviews of the work of other authors was not followed by his successors. Perhaps influenced by Rafinesque's procedure, the unwritten law that reviews should not be made the media for publishing new names became universally established over a century ago. Rafinesque's overlooked paper of 1834 is listed in the Royal Society's *Catalogue of Scientific Papers* (**5**: 76, 1871), but I have elsewhere seen no references to it; it is not mentioned in Fitzpatrick's[5] comprehensive bibliography of Rafinesque, which contains 940 numbered items.

In the course of my examination of Rafinesque's publications it soon became manifest that various other important papers of this author had not been indexed. I was aware of the fact that this applied to the rather extensive and very rare *Autikon Botanikon* (1840), which was printed in Philadelphia in the year of Rafinesque's death. Here, because no copy was available, the new generic names were not listed in *Index Kewensis* until its seventh supplement appeared in 1929. The entries for 83 new generic names were made from Pennell's[6] paper; the several hundred new binomials that appear in the *Autikon Botanikon* are still unlisted. Incidentally, a modern lithoprint facsimile edition of this rare work has recently been issued under the auspices of the Arnold Arboretum, and it is now generally available for the first time, since most of the limited original edition was apparently destroyed in Philadelphia after Rafinesque's death. There is reason to believe, from Rafinesque's own statement regarding certain other volumes published shortly before 1840, that only 160 copies of this work were printed. At any rate, only about a dozen copies of the *Autikon Botanikon* are known to be extant, it apparently being much more rare in European libraries than it is in those of the United States. I was not fully prepared to discover that various other complete volumes and pamphlets published by Rafinesque had been overlooked by the compilers of our standard indices, and that overlooked, ob-[112]scurely published new names in papers that had been indexed were fairly numerous.

Having direct access to all but very few of Rafinesque's known botanical papers and books, I completed the record by securing the essential data from other sources in the United States and England. With a complete set of published data available, as far as Rafinesque's actual publications are known, I then undertook the time-consuming task of indexing all of Rafinesque's new names in the botanical field. The normal procedure was to transfer to large index slips all that Rafinesque published about each entity, whether it were a new genus, subgenus, species, or variety, or merely a substitute name. The total number of these slips is between 10,000 and 12,000. While this study has not progressed to a point where I can make even an approximate estimate of the total number of new names proposed by Rafinesque in all categories, he did originate a total of about 3,000 new generic

[5] **Fitzpatrick, T. J.** Rafinesque. A sketch of his life with bibliography. Des Moines: 1-241, 32 pl., 1911.

[6] **Pennell, F. W.** "Unrecorded" genera of Rafinesque. Bull. Torr. Bot. Club **48** (3): 89-96, 1921.

and subgeneric names. The expectation is that there are between 1,200 and 1,500 Rafinesque plant names, in all categories, that have been entirely overlooked by botanists in that they do not appear in any of our standard indices. After a lapse of a century it seems to be desirable that these generic and specific names (for the most part validly published) be at least listed.

When the slips were sorted by major groups, such as algae, fungi, lichens, mosses, pteridophytes and phanerogams, it became possible to initiate preliminary work on the preparation of the actual lists. That for the pteridophytes has been completed and checked. Of the 62 new names published by Rafinesque in this group, it was found that most of them had been overlooked. Within the field covered by Christensen's *Index Filicum* and its three supplements, there are actually 54 Rafinesque names, but of these Christensen detected only 8, and the entries to half of these are not to the original places of publication. In the algae about 60 new generic names were proposed, in the fungi about 55, and in the lichens 3. Apparently most of the names in these last three major groups have been overlooked. The number of new generic and specific names for the phanerogams is very much larger.

Lest some reader of this statement be fearful that the mere listing of the Rafinesque names overlooked for more than a century will unduly upset nomenclature, let me hasten to record that for the pteridophytes as a group only one Rafinesque generic name and one binomial stand. The former is *Pteretis* Raf. (1818), which should replace *Struthiopteris* Willd. (1809) (non Weis., 1770, nec Bernh., 1801), *Matteuccia* Todaro (1866), and *Pterinoides* O. Kuntze (1891), while the latter is *Equisetum praealtum* Raf.; and various botanists have long since accepted both. I do not think that many nomenclatural changes will result through listing the very much larger number of names for the phanerogams. Most of the necessary changes in reference to binomials will be through the application of the homonym rule, and the percentage here will be small.[7] Where Rafinesque's properly published generic names antedate those of other authors currently accepted for the same group (and there will be a number of these), it is always possible to invoke the principle of *nomina generica conservanda*.

The chief reason for listing the multitudinous overlooked Rafinesque names is, of course, the homonym rule. It is suspected that the majority of botanists would be perfectly willing to outlaw all of Rafinesque's publications were it possible to do so, but as a considerable number of his generic names and binomials have always been accepted, and many more should have been accepted, it is difficult to see how his papers could be outlawed without abandoning his universally accepted names. Throughout Rafinesque's publishing career he proposed and described genera and species that were not only acceptable to his contemporaries, but also to his succes-

[7] I realize very fully that some of the conservative botanists will echo "Why bring that up?" at the mere suggestion that Rafinesque's numerous names, overlooked for more than a century, be now listed. Yet a nice species of *Trillium* has been named in honor of one of these botanists, because in 1906, when *Trillium declinatum* (A. Gray) Gleason was published, its author did not know that in 1840 Rafinesque had described an entirely different *Trillium declinatum* Raf. from Alabama and Florida; Rafinesque's binomial is not listed in *Index Kewensis*. Thus we now have *Trillium Gleasonii* Fernald replacing *T. declinatum* Gleason 1906, non Rafinesque 1840. If an argument is needed to support the listing of Rafinesque's overlooked names, here it is.

sors, and these names are everywhere used. The following generic names proposed by Rafinesque illustrate this point: *Distichlis, Eatonia, Stenophyllus, Peltandra, Clintonia, Protanthera, Hexalectris, Nestronia, Ofaiston, Phyllipedium, Adlumia, Polanisia, Nemopanthes, Cladrastis, Nirwamia, Pachystima, Didiplis, Osmorhiza, Spermolepis, Ptilimnium, Cymopterus, Meriolix, Oreoxis, Lomatium, Oxypolis, Steironema, Synallodia, Stylisma, Ilysanthes, Endopogon, Blephilia, Lepachys, Erechtites, Serenia,* and *Agoseris.*

[113] As expressed by Fernald,[8] "The task of sifting the comparatively few perfectly sound grains from the chaff and the distorted or unrecognizable grains is a thankless one and, above all, it should be undertaken only by those with intimate knowledge of the floras concerned." What this sifting process means may be illustrated by the statement that, including the above Rafinesque generic names and about 75 others that have been eliminated through the application of the principle of *nomina generica conservanda,* the number that modern botanists might accept, *on the basis of strict priority, is actually less than five percent, of the total that Rafinesque proposed.* Contrast the work of Linnaeus, where about 99 percent of the names that he adopted are still accepted. The discrepancy here is not due to the "weight of authority" but is an excellent index to Linnaeus' good judgment as opposed to the erratic judgment of Rafinesque. Some idea of the percentage of Rafinesque's proposed generic names that can be definitely placed, either as valid entities or as synonyms, is indicated by the fact that De Dalla Torre and Harms (*Gen. Siphonogam.:* 583–586, 1906) listed only 11 of Rafinesque's genera under their heading *genera incertae sedis;* that is, those that have not been referred to their proper families. The actual number of Rafinesque's genera that cannot be definitely placed will probably prove to be considerably larger than this, but some of these 11 can probably be placed on the basis of future investigations. While Rafinesque's record of valid or possibly valid genera is exceedingly poor, the record of his attempts to delimit species on the basis of actual specimens is scarcely better. I cite three cases. In *Clintonia* he described 18 species, in *Dodecatheon* 15, and in *Trillium* 35. Modern botanists, working on the floras of the same geographical regions whence Rafinesque's specimens came, have been able to recognize but 2 species of *Clintonia,* 1 of *Dodecatheon,* and 20 of *Trillium;* and not a single Rafinesquian binomial in these three genera has been adopted by his successors.

There are numerous cases where Rafinesque's proposed and validly published generic names actually antedate those in current use, but many of these have been included in the list of rejected names, for other names published later by various authors have been included in the list of *nomina generica conservanda* approved by the International Botanical Congresses. Examples of these are: *Bulbilis* Raf. (1819), replaced by *Buchloe* Engelm. (1859); *Diarina* Raf. (1808), replaced by *Diarrhena* Beauv. (1812); *Spathyema* Raf. (1808), replaced by *Symplocarpus* Salisb. (1818); *Megotigea* Raf. (1836) [1837], replaced by *Halicodiceros* Schott (1853); *Hexalepis* Raf. (1836) [1838], replaced by *Vriesea* Lindl. (1843); *Pogomesia* Raf. (1836) [1837], replaced by *Tinantia* Scheidw. (1839); *Piaropus*

[8] Rhodora 34: 21, 1932.

Raf. (1836) [1837], replaced by *Eichhornia* Kunth (1843); *Chrosperma* Raf. (1825), replaced by *Amianthium* A. Gray (1837); *Pubilaria* Raf. (1836) [1837], replaced by *Simethis* Kunth (1843); *Amblostima* Raf. and *Oxytria* Raf. (1836) [1837], replaced by *Schoenolirion* Durand (1855); *Laoethoe* Raf. (1836) [1837], replaced by *Chlorogalum* Kunth (1843); *Geboscon* Raf. (1824) and *Periloba* Raf. (1836) [1837], replaced by *Nothoscordium* Kunth (1843); *Quamasia* Raf. (1818) and *Cyanotris* Raf. (1818), replaced by *Camassia* Lindl. (1832); *Diphryllum* Raf. (1808), replaced by *Listera* R. Br. (1813); and *Cordula* Raf. (1836) [1838], replaced by *Paphiopedilum* Pfitz. (1886). I have here covered only the monocotyledonous families, but there are approximately 55 additional cases in the dicotyledonous groups or a total of about 75 cases where earlier and validly published Rafinesque generic names have been officially eliminated in favor of later ones published by other authors. The list must eventually be considerably increased if we are to avoid nomenclatural changes due to the discovery of still other generic names published by Rafinesque at dates earlier than those of other authors now currently accepted.

This is a rather deplorable record in view of the generally accepted principle of priority in taxonomy. While our rules of nomenclature are impersonal, yet it seems to be evident that modern botanists are just as unimpressed with the character of Rafinesque's work as were his contemporaries; and his contemporaries merely ignored much of his work under the assumption that it was not necessary to consider his findings. After all, the blame rests very largely with Rafinesque because of his usually inadequate methods of presentation, brief and sketchy descriptions, and his habit of publishing in out-of-the-way places. Numerous shorter papers were published in some ten different American magazines, twelve European and British ones, and in no less than seven "personal" periodicals that he hopefully initiated from time to time, but most of [114] which never attained more than volume one, number one, and few saw the completion of more than one, or at most two volumes. Rafinesque's tendency to scatter his shorter papers in strange places is discussed somewhat in detail in a previous paper,[9] where the titles of ten American serials and twelve European ones, that he favored by submission of manuscripts to their editors, are listed. Most of these are not in any sense of the word botanical periodicals. The period covered is from 1803 to 1841. Most of these periodicals are not normally found in the libraries of even the largest botanical institutions in this country or abroad.

This problem of inaccessibility applies not only to the types of periodicals in which Rafinesque published numerous technical papers, but also to his small, independently published pamphlets and to his larger books. In two cases I have been able to locate only single copies in all of our libraries, and curiously, although one of them, the *Herbarium Rafinesquianum,* was actually published in Philadelphia in 1833, there seems to be no copy of it in any of the Philadelphia libraries. The *Western Minerva* was published in Lexington, Kentucky, in 1821, and of this only a single copy, in the library of the Academy of Natural Sciences of Philadelphia, is known to exist. Regarding it Rafinesque states that he was able to save but three

[9] Proc. Am. Philos. Soc. **86** (1): 78, 1942.

copies, as the irate printer destroyed the entire stock. In his *Life of Travels* (p. 66, 1836), Rafinesque states that this action was due to his secret enemies, but the probability is that he was unable to pay the printing bill. Yet it is understandable that some of his associates in Lexington, Kentucky, might have been disturbed by some of the articles included in this, the rarest of his publications. He wrote a letter to Bory St. Vincent which he actually published in his *Western Minerva* (**1**: 71–74, 1821), printed in the town where he was then residing and which was then known as "The Athens of the West." He refers to certain of his fellow townsmen as follows:

> A set of unfortunate individuals, who have two eyes; but cannot see: their minds are deprived of the sense of perception: they are astonished and amazed at my discoveries, are inclined to put them in doubt and even to scoff at them. . . . Our catfishes, eels, shads, sturgeons &c. are for them mere fish to fill their stomach! and moreover they are all of European breed, and were carried here by Noah's flood direct from the Thames, the Seine and the Rhine!—I let them rail to their heart's content, and I laugh at them. . . . It is only in Europe that my labors and discoveries may be fully appreciated: here I am like *Bacon* and *Galileo*, somewhat ahead of my age and my neighbors. . . . The Western Minerva has been threatened before her birth.

All of which may well have had at least a shadow of truth, but which, nevertheless, was an evidence of lack of tact on the part of Rafinesque, considering the time and place.

Throughout Rafinesque's copious writings one notes this tendency to criticism, and the reiteration of claims that he (Rafinesque) was always right and that those who differed from him were wrong. This attitude, combined with his strange ideas regarding classification and nomenclature, and his unorthodox methods of publication, went far in alienating his contemporaries who were working in similar fields. He was obsessed with the idea of discovering new genera and new species, and the establishment of these actually became a monomania. This, however, is no place in which to discuss the idiosyncracies of such a remarkable character as Rafinesque.

Even Rafinesque's larger publications, such as his *Medical Flora* (1828–1830), *New Flora and Botany of North America,* four volumes (1836–1838), *Flora Telluriana,* four volumes (1836–1838), *Sylva Telluriana* (1838), the *Good Book or Amenities of Nature* (1840), and the *Autikon Botanikon* (1840), are exceedingly rare, and copies are unobtainable today. The reasons for their scarcity are the time and place of publication (Philadelphia, 1828–1840); the fact that they were for the most part privately published by Rafinesque; their very limited sale; the limited editions (apparently about 160 copies only, this being definitely the case with the *Flora Telluriana*); and the fact that when Rafinesque died in 1840 his effects were sold at auction to satisfy the demands of his creditors. Apparently the unsold stock of his numerous publications was disposed of as waste paper.

Attention should be called to the fact that the various volumes mentioned above were essentially media in which Rafinesque published his findings in reference to the classification and nomenclature of plants. Thus his *New Flora and Botany of North America* is not a descriptive flora in any sense of the word, but consists largely of additions that Rafinesque

made to the subject, most of the items included being proposals of new genera and new species. The same is true regarding his *Flora Telluriana* and his *Sylva Telluri-*[115]*ana*—neither in any sense treats the genera and species of the world, but chiefly those forms that Rafinesque considered to represent new genera and new species. The same statement applies to his *Alsographia Americana,* the *Good Book or Amenities of Nature,* and the *Autikon Botanikon.* As four of these works apply to the world at large, rather than merely to the flora of the Eastern United States, they should have a place in every large botanical library, particularly libraries of institutions wherein systematic work is an important activity.

The net result of Rafinesque's long-continued publication methods is that even in most of our larger botanical libraries many of his publications are missing; and as this is true of the specialized American libraries, it is even more so in regard to those of Europe. With us there are excellent collections of Rafinesquiana at the Gray Herbarium, the Arnold Arboretum, the New York Botanical Garden, the Academy of Natural Sciences of Philadelphia, the Smithsonian Institution, and the Library of Congress. I judge that from a botanical standpoint the magnificent assemblage at the Arnold Arboretum is by far the most complete; and yet this lacks several Rafinesque items. It is suspected that the paucity of Rafinesque publications in European libraries is reflected by the fact that in the second edition of his *Thesaurus* (1872) Pritzel listed only four Rafinesque titles, although in the first edition (1851) he included sixteen, most of which he apparently never saw.

Naturally, with his fixed ideas that species and genera were constantly being formed, and that both genera and species should be established on the basis of very slight differences, Rafinesque proposed and named very numerous entities as genera, subgenera, species, and varieties. That more of his generic and specific concepts have not been accepted is more a reflection on his judgment than on the judgment of his contemporaries and successors. As noted above, the total number of new generic and subgeneric names actually published by Rafinesque approximates 3,000, thus placing him in a category by himself in the number of these units that he thought should be recognized. I know of no author who proposed so many generic names, for even Linnaeus, taking up numerous names originated by his predecessors, recognized less than 1,600. The very fact that among these 3,000 Rafinesquian generic names only about 25 are currently accepted as valid, while about 75 others have been placed in the list of *nomina generica rejicienda* is in itself another reflection on Rafinesque's judgment; for in segregating genera good judgment is basically most important. Probably Adanson (*Familles des plantes* **2**:1-640, 1763) originated more new generic names than any single botanist since Linnaeus, with the exception of Rafinesque; or at least he is credited with having originated them. As a matter of fact, the total that he recognized is approximately the same number that Linnaeus recognized, somewhere in the neighborhood of 1,600. Most of these were adopted from such pre-Linnaean authors as Hippocrates, Theophrastus, Pliny, Dioscorides, Avicenna, Pontedera, Dillenius, Vaillant, Tournefort, Heister, Fuchs, Loefling, Ray, Plukenet, Plumier, Lobelius, Micheli, Dodoens, Camerarius, Gronovius, Hermann, Gesner, Ruppius, Celsius, Brunfels, Buxbaum, Cordus, Ammann,

P. Browne, Houstoun, Kaempfer, Rheede, and Rumphius, together with a certain number that Linnaeus originated. In the index to his work Adanson actually credits to himself the authorship of less than 200 of the names he published, although currently his name is cited as the authority for many more than 200, because he first assigned to many earlier names an approximation of generic form. Rafinesque occupies the unique position of having originated infinitely more new generic names than any other botanist in the entire history of the science, and yet at the same time one whose proposals have met with the smallest percentage of acceptance, for the possible acceptance of less than five percent of approximately 3,000 new names speaks for itself; and yet uninformed individuals have, at times, spoken of Rafinesque as a "great" botanist. Clearly it takes more than the mere publication of many hundreds of papers and many thousands of new generic names and binomials to deserve the characterization "great." The average botanist's work is not judged so much by his immediate associates and co-workers as it is by posterity; and posterity has been particularly hard, although scarcely unfair, in its judgment of the nature of Rafinesque's work. Rafinesque's confidence in his own judgment was no less than superb, and he claims, in various of his writings, that posterity would justify his attempts at clarification of classification of both plants and animals. Unfortunately for Rafinesque, posterity was and still is as unimpressed as were his contemporaries.

While Rafinesque described a great many new genera and new species *de novo* on the basis of [116] actual specimens, he based an extraordinarily large number of his "new" entities on the published work of other authors. It is apparent that if, in scanning a published description or illustration, he noted the slightest discrepancy between the characters as given by this or that author, and his or other botanists' concept of the same genus or species, he proposed a new generic or specific name (or both) on the basis of the description before him; and the noted "differences" might well be due to the personal equation, rather than any actual differences. He apparently disbelieved in the unusually wide geographical distribution of individual species, and I judge that many of his units were proposed, named, and described because he could not accept, in general, the idea that any species could be of very wide geographical range.

He proposed his own laws of nomenclature,[10] and many of the changes in both generic and specific names were made because of his confidence in his own rules—rules that other botanists never accepted. If a generic name was too short, he lengthened it, as *Leea* Linn. = *Leeania* Raf., *Inga* Willd. = *Ingaria* Raf., *Cola* Schott = *Colaria* Raf., *Neea* Ruiz and Pav. = *Neeania* Raf., *Rhus* Linn. = *Sumachium* Raf., *Zea* Linn. = *Mayzea* Raf., *Poa* Linn. = *Poagris* Raf., *Chloris* Sw. = *Chlorostis* Raf., *Donia* R. Br. = *Doniana* Raf., and *Crypta* Nutt. = *Cryptina* Raf., *Cryptella* Raf., and *Cryptaria* Raf. (these three new names actually published in a single line!). If names were too long, or as he said, uncouth in sound, these were also changed, such as *Tabernaemontana* Linn. = *Tabernaria* Raf.,

[10] **Rafinesque, C. S.** Principes fondamentaux de somiologie ou les loix de la nomenclature et de la classification de l'empire organique ou des animaux et des végétaux. Palerme: 1-51, 1814. Also Flora Telluriana 1: 81-90, 1836 [1837] (Philadelphia).

Lightfootia L'Hér. = *Lifutia* Raf., *Calamagrostis* Roth. = *Amagris* Raf., *Stachytarpheta* Vahl = *Tarpheta* Raf., *Carludovica* Ruiz and Pav. = *Ludovica* Raf., and *Krasheninnikofia* Gueldst. = *Kranikofa* Raf. (1814), *Kranikovia* Raf. (1837), and *Krasnikovia* Raf. (1837). Names that he designated as "mongrel," part Latin and part Greek, he changed at will, for this reason abandoning *Vincetoxicum* Linn. in favor of *Gonolobus* Michx., and changing *Scyphofilix* Thouars to *Scyphopteris* Raf., while for such a name as *Pteris* Linn., which he correctly says merely means fern, he at various times proposed no less than five substitutes—*Peripteris* Raf., *Pterilis* Raf., *Lemapteris* Raf., *Phyllitis* Raf., and *Pteridium* Raf. He was just as casual in his treatment of specific names proposed by other authors when, for any reason, he considered that they did not apply, and he changed a great many of them at will. A good illustration is his treatment of *Floerkea proserpinacoides* Willd. (*Am. Jour. Sci.* **1**: 373–376, 1819): "a long and uncouth specific name which has been changed by every subsequent author." He then proceeded to list *F. uliginosa* Muhl., *F. lacustris* Pers., and *Nectris pinnata* Pursh as representing the same species, and although expressing a preference for Muhlenberg's name, he most casually proposed three others: "Did I think myself permitted to coin a new name, while so many have been proposed already, I should have called it either *F. tenella,* or *F. flaccida,* or *F. olitoria.*" Regarding names, he states (*Fl. Tellur.* **1**: 16–17, 1836 [1837]): "I am never at a loss for names, as Linnaeus was when he framed *Quisqualis;* I could readily supply 20,000, *all good*"; he literally spawned new names! As an extreme example of the most casual manner in which Rafinesque proposed new names, I cite the following case from his *Sylva Telluriana* (p. 85, 1838):

> 500 CARPUPICA Raf. probably another distinct G. Type *C. odorata* Raf. Piper carpupija R. P. tree of Peru with fragrant leaves—Piper methysticum and Churumaya are also probably types of other Genera ? to be called *Methysticum esculentum* Raf. and *Churumaya arborea* Raf. Is not Piper betel another ? to be called *Betela mastica* Raf.?

All these new names are readily placeable in synonymy, for Rafinesque actually designated the type of his genus *Carpupica,* and lists the binomials on which *Methysticum, Churumaya,* and *Betela* are based; none of these can be considered as validly published.

While I have above indicated that Rafinesque's very numerous nomenclatural innovations have received short shrift at the hands of his contemporaries and successors, in that only about 25 of his new genera have been more or less generally accepted, and that about 75 of his names that were actually earlier than currently used ones published by other botanists have been placed in the list of *nomina generica rejicienda,* still there are a number of additional cases that need to be treated on their merits. I cite only a very few to illustrate this point. *Shortia* Raf. was published in 1840, and *Shortia* Torr. and Gray was published in 1842. Technically the latter should [117] be replaced by *Schizocodon* Sieb. and Zucc. (1843) or *Sherwoodia* House (1907). It is suspected that when this case is brought before a properly constituted international body, *Shortia* Torr. and Gray (1842) will be retained, because *S. galacifolia* Torr. and Gray is a name now rather widely used in horticulture; *Shortia* Raf. (1840) is a synonym of *Arabis* Linn. The case of *Delonix* Raf. is in a different category. Under

all rules this is the proper generic designation for the now universally distributed tropical tree known as the flamboyant, flame tree, fire tree, or royal Poinciana. While *Delonix* Raf. has been adopted by a considerable number of botanists, it is curious to note how consistently the conservative botanists still continue to designate the species as *Poinciana regia* Bojer, the binomial under which it was originally described; but the type of the genus *Poinciana* is *P. pulcherrima* Linn. = *Caesalpinia pulcherrima* (Linn.) Sw.; Bojer did not describe his entity as a new genus, but erroneously placed it in the Linnaean genus where it does not belong. This very characteristic and striking species should be known as *Delonix regia* (Boj.) Raf. *Hebokia* Raf. (*Alsogr. Am.:* 147, 1838) is an older name than *Euscaphis* Sieb. and Zucc. (1840) and is validly published; it was based wholly on *Sambucus japonica* Thunb. = *Euscaphis japonica* (Thunb.) Kanitz. To avoid a change in the generally accepted name for this particular genus, it will be necessary to conserve the later name by appropriate action, but as yet no one has proposed such action.

I hold no brief for the acceptance of *Rytilix* Raf. for the characteristic grass genus currently known as *Hackelochloa* O. Kuntze; all that Rafinesque says (Seringe, *Bull. Bot.:* 219, 1830) is: "III. *Rytilix* (Rafin. in litt.) *Manisuris granularis* et *myurus* auct. 1. *R. glandulosa* (Rafin. mss.)". *Manisuris granularis* Linn. f. and *M. myurus* Linn. are not congeneric, the former being a species of *Hackelochloa* and the latter a species of *Rottboellia*. Had O. Kuntze known of this most sketchy "publication" of *Rytilix* Raf., he might have accepted it instead of proposing the new name *Hackelochloa* in 1891; and yet there is no way of determining on which of the two cited synonyms *Rytilix glandulosa* Raf. was based except by arbitrary selection. *Cenchrus granularis* Linn. = *Manisuris granularis* Linn. f. = *Rytilix granularis* Skeels = *Hackelochloa granularis* O. Kuntze; *M. myurus* Linn. = *Peltophorus myurus* Beauv. = *Rottboellia myurus* Benth. I personally consider that Rafinesque's publication is invalid, in that he gave no generic description and based his new generic name on binomials only. Clearly in this case the action of the International Congress in conserving *Hackelochloa* O. Kuntze (1891) over *Rytilix* Raf. (1830) was correct.

It is not anticipated that any botanist will agree with Rafinesque in his extreme views as to the limits of genera and species, although some of our modern botanists both in Europe and in America seem to approximate his viewpoint, if we may judge by the very tenuous characters by which some specialists now differentiate both genera and species. It seems to be evident that the present tendency in systematics is to subdivide the larger and more or less complex genera, although it is inconceivable that any individual will go to the extremes that characterized Rafinesque's work. This point is brought up merely to emphasize the fact that if a modern botanist decides to subdivide a large and complex genus, it may not be necessary for him to originate new generic names for certain segregated groups. In many cases it is evident that some of Rafinesque's published names will serve, for whatever else he did, he usually indicated the type. It is thus usually possible to interpret his proposed genera and subgenera, especially when his new names were based on bibliographical references. As these

numerous Rafinesque names were for the most part validly published, no reason exists for not accepting those that can definitely be placed.

I list here a part of the genera that Rafinesque subdivided, in order to bring to the attention of those botanists, who may be inclined to subdivide these groups, the fact that in some cases Rafinesque may have forestalled them and that he may have proposed a name, or names, for a group or groups, that they now feel to be worthy of generic status. Among the genera that Rafinesque subdivided are: *Acacia, Acer, Achyranthes, Aesculus, Agrostis, Albizzia, Allium, Amaryllis, Andropogon, Ardisia, Aristida, Aristolochia, Arum, Aspalathus, Aster, Atropa, Avena, Baeckea, Bauhinia, Bignonia, Bumelia, Camellia, Campanula, Capparis, Carex, Casearia, Cassia, Cissus, Cistus, Cleome, Commelina, Convolvulus, Conyza, Cordia, Cornus, Crotalaria, Croton, Cuphea, Cuscuta, Cyperus, Cypripedium, Cytisus, Daphne, Dendrobium, Dianthera, Drosera, Echium, Ehretia, Elaeocarpus, Epidendrum, Eugenia, Euphorbia, Festuca, Ficus, Fraxinus, Gentiana, Gerardia, Geum, Gossypium, Gypsophila, Habenaria, Helianthemum, Helicteres, Heliotropium, Hicora, Hy-*[118]*pericum, Ilex, Inula, Ipomoea, Jussiaea, Justicia, Lantana, Laurus, Leersia, Leucas, Litsea, Loranthus, Lycium, Lythrum, Melastoma* (including *Miconia* and other genera), *Mimosa, Myrica, Myrtus, Neottia, Nicotiana, Origanum, Ornithogalum, Osbeckia, Pancratium, Panicum, Passiflora, Peperomia, Phyllanthus, Phlomis, Physalis, Piper, Poa, Polygala, Polygonum, Pontederia, Populus, Quercus, Reseda, Rhamnus, Rhexia, Rhus, Rubus, Ruellia, Salix, Salvia, Sambucus, Saxifraga, Scabiosa, Scilla, Scirpus, Scleria, Sideroxylon, Smilax, Solidago, Spiraea, Sterculia, Stipa, Teucrium, Tilia, Tradescantia, Uniola, Urtica, Utricularia, Veronica, Viburnum, Vitis,* and *Xyris.*

As an extreme case in generic segregations, Rafinesque's treatment of the large genus *Carex* may be cited. In his paper, published in 1840,[11] he recognized 22 genera as segregates from *Carex,* of which 19 were briefly defined as new, and under these 22 generic names he published about 130 new binomials. Few of these generic and specific names, to my knowledge, have ever been cited in botanical literature since they were published, and none of them, or the numerous other new names that appear in the *Good Book,* are listed in *Index Kewensis.* Apparently even modern facsimile reprinting of rare publications is no guarantee that the often numerous new names that appeared in the original will thus be included in current indices. Clearly, if one were tempted to follow Rafinesque's example and segregate various genera from *Carex* Linnaeus, as currently understood, one would here find names already published for at least certain groups.

As one scans monographic treatises issued within the past century, wherein some of these numerous genera are considered, one rarely notes a Rafinesque name that has been accepted, even for minor categories such as subgenera or sections. The usual procedure in such groups as *Quercus,*

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[11] **Rafinesque, C. S.** The natural family of Carexides. Good Book: 23-28, 1840. A facsimile reproduction of this paper was issued under the auspices of the American Midland Naturalist in 1913. At the same time another overlooked paper that was published in the Good Book was reissued, this being Rafinesque's "Scadiography of 100 Genera of Ombelliferous Plants, chiefly New, with their Types &c." (Good Book: 49-61, 1840, facsimile reprint 1913).

Aristolochia, Carex, Croton, Gentiana, Melastoma, Polygonum, Ficus, Piper, Phyllanthus, and other large genera has been to propose names for secondary groups *de novo,* when, in some cases, it would have been perfectly feasible to have accepted names previously proposed by Rafinesque (as genera), utilizing these as designations of minor categories. As Rafinesque's publications frequently antedate those of certain monographers, this would have been a perfectly logical course to pursue. It is refreshing to note that within the past decade at least one botanist has had the courage of his convictions and has utilized certain Rafinesquian generic names, such as *Pythiusa* Raf., *Tulocarpa* Raf., and *Murtekias* Raf., as the designations of sections and subgenera.[12]

In spite of Rafinesque's often erratic work, I am inclined to dissent from the type of "argument" discussed below. In the long article on "Conservation of Later Homonyms" (*Kew Bull.* 409, 1935, sub *Claderia* Hook. f.), this name (1890) is retained in preference to the much earlier *Claderia* Raf. (1838), on this basis: "Rafinesque's genus, though technically published, must apparently be synonymous with *Melia* L., *Azadirachta* Juss. (1830) or *Murraya* L.; and it represents a kind of pseudo-scientific work, the nomenclatural results of which may well be legislated out of existence." The general approval of such a principle would open a veritable Pandora's box, for in systematic botany who shall define the limits of "pseudo-scientific" work? Very little reason exists for retaining *Claderia* Hook. f. if a better argument than the above cannot be devised; it was Hooker's error in selecting a generic name that had already been used for an entirely different group, and in retaining it we merely condone his error. Here is a case where the weight of authority intervenes, for Hooker's botanical work was on a plane so infinitely higher than was that of Rafinesque that the two can scarcely be compared; were the situation reversed, there is no chance that Rafinesque would have received corresponding consideration.

While in no respect should this contribution be considered as an argument in support of Rafinesque's general type of work, it is hoped that its publication will bring to the attention of other than American botanists the desirability of at least considering Rafinesque's generic entities when monographic work is undertaken, or when local floras are under consideration. Had the botanists of the world in the past had the opportunity of becoming acquainted with the scope of Rafinesque's publications, I might not have had [119] to cite the rather unflattering figure of 75 of his generic names that have been officially placed in the limbo of *nomina generica rejicienda,* largely because his contemporaries and successors in Europe were unfamiliar with what Rafinesque had already proposed, and thus redescribed the same groups under different names at later dates. This is, in a way, a reflection on the bibliographical researches of various botanists whose later generic names have been officially accepted in order to avoid undue changes in currently accepted binomials through a strict application of the rule of priority. It is clear that the vast majority of Rafinesque's published generic names can be definitely placed, but to do

[12] **Prokhanov, J. Conspectus systematicus Tithymalorum Asiae Mediae. (Trans. Rubber and Guttapercha Institute.) Moscow: 1-241, 70 fig., 46 maps, 1933.**

this individual authors need to have access to his publications. When one of his names is found to be valid, there is really little excuse for coining a new one to designate the same natural group; one that in order to stand the test of time must, perhaps, be approved at some future session of the International Botanical Congress. From a purely bibliographical standpoint Rafinesque's botanical publications are distinctly worthy of careful consideration, no matter how much his work may be criticized; and his work is, on the whole, eminently worthy of severe criticism. It is to be regretted, in justice to him, that the necessity of considering what he proposed was not realized at an earlier date. Asa Gray[13] recognized this in the year following Rafinesque's death, for in 1841 he stated: "Many of Rafinesque's names should have been adopted; some as a matter of courtesy, and others in accordance with strict rule." A century later about the best we can do, when it is discovered that a Rafinesque generic name antedates a currently accepted one proposed by some other author, in ignorance of what Rafinesque published, is promptly to add the Rafinesque name to the already over-long list of *nomina generica rejicienda*. This, in Asa Gray's words, is neither courteous nor in accord with strict rule. We who follow the cult of Flora, in times of old worshipped by the Romans, might at least recall the words of Ovid: "Pascitur in vivis livor. Post fata quiescit, cum suus ex merito quemque tuetur honos."

[13] Am. Jour. Sci. 40: 234, 1841.

— XXI —

SIR DAVID PRAIN (1857-1944)*

[379] The career of Sir David Prain reads more like that of some young American, who, starting with little other than his innate [380] ability, reached eminence, rather than what we are inclined to associate with success under British conditions. He was the son of relatively poor parents and at the beginning lacked the support of powerful or wealthy associates, until by his actual accomplishments he commanded the respect, admiration, and high regard of a very wide circle of powerful men, becoming, in a sense, an elder statesman of high order from the ranks of botany. His father, member of a large family, native to the region between Dundee and Perth, commenced to train as a teacher, but the needs of his younger brothers did not permit him to finish this work, and he was accordingly apprenticed to a saddler. Eventually he became an employee of a contracting firm engaged in railroad construction and finally purchased a saddlery business in Fettercairn, Kincardinshire, Scotland, where young David was born, July 11, 1857.

Prain attended the Parish School in Fettercairn, his first objective being a clerkship in a Glasgow bank which accepted him at the age of fifteen with the proviso that he attend a larger school for one year. To conform to this condition he entered the Aberdeen Grammar School. His former Parish School teacher was not content that young Prain should become a bank clerk, and made a special trip from Fettercairn to Aberdeen for the express purpose of persuading Prain to enter the University; and he was able to fortify his argument by being able to say that Prain could have a bursary of £25, if he did so, from a Fettercairn landlord who was seeking a likely lad on whom to bestow it. Thus Prain entered the University of Aberdeen at the age of sixteen with the intention of preparing himself for the teaching profession. His passage through the university was difficult because of financial considerations, and the fact that he had to teach during the long vacations. Through this experience he learned that no application for permanent employment was likely to be received favorably unless he could say that he had an honors degree. This he took in the natural sciences with botany as his major subject. Following his graduation from the University of Aberdeen, he being the recipient of the M.A. degree with honors, he taught for two years in Kent.

While in the university, Professor Trail, under whom he had studied botany, required him to register as a medical student, as botany was then a required course for the M.D. degree. While he had at first no intention of studying medicine as a profession, he found that by frugal living at Ramsgate he could save a considerable [381] part of his salary. Accordingly he returned to Aberdeen in 1880, taking two years in medicine there followed by a third year at the University of Edinburgh, being graduated with the highest honors, in 1883.

Sir George King, then Director of the Royal Botanic Garden at Cal-

* E. D. Merrill, "Sir David Prain (1857-1944)" (Year Book of the American Philosophical Society, 1944, pp. 379-383, 1944).—Two minor corrections have been made by the author in the original text.

cutta, home on leave, enquired of Professor Trail if he knew of some young medical student with a leaning towards botany who might be interested in entering the Indian Medical Service; the idea was passed on to Prain who applied, and who in the competitive examination led all other candidates. In the fall he went to the Royal Military Hospital at Netley, and in 1885 proceeded to India where he remained until he was appointed Director of the Royal Botanic Gardens at Kew in 1905. His first botanical post was at the Royal Botanic Gardens, Calcutta, where for a short time, he occupied the position held by Brace, who was absent on sick leave. In January 1887 Brace returned to England, and Prain, who was then on duty in Kohima, was called to Calcutta where he was appointed Curator of the Herbarium and Librarian, positions that he filled until the retirement of Sir George King in 1898, when he was appointed Superintendent.

The intervening years were busy ones, for in this period Prain not only prepared and published many important botanical papers, occupied the Professorship of Botany at the Calcutta Medical College, and took part in various exploring expeditions, but was also called upon to straighten out the very unsatisfactory conditions that had developed in relation to the Government Cinchona plantations in Sikkim, a task that he performed admirably, clearly demonstrating his remarkable business ability, and in no unmistakable manner indicating to the Indian authorities what must be done. He was an admirable administrator, which led to his assignment to numerous special tasks in India, and later in England after his return to that country.

These very numerous non-botanical activities continued long after his retirement as Director, Royal Botanic Gardens, Kew, in 1922, some of them practically to the day of his death. In addition to revitalizing the work at the Royal Botanic Gardens at Kew, the preparation of technical taxonomic contributions to the flora of tropical Africa, and work with Mr. I. H. Burkill on the genus *Dioscorea,* the government commenced to place him on special committees and councils. His services were in special demand in [382] reference to indicating how to direct research, and the work of the various groups on which he served cleared the way for the great Educational Bills aimed at completely remodelling the British instructional system. In the field of educational reform he made many public addresses in favor of the projected changes, the most important one being that on behalf of the British Science Guild at Liverpool University in 1930.

Nor were his activities confined to government agencies. Some idea of the diversity of his interests may be gained from the fact that he served on the Council of the School of Tropical Agriculture, Trinidad, and the John Innes Horticultural Institution, being the Chairman of the latter board from its inception to shortly before his death, and Vice-Chairman, later Chairman, of the former, Chairmanship of the Advisory Committee on Vegetable and Animal Products Committee of the Imperial Institute, Trustee of the British Museum, Member of the National Trust, Mycological Institute, Entomological Institute, Scientific Committee of the Royal Horticultural Society, and for ten years Treasurer of the Royal Society from 1919, and as a Herbert Spencer Trustee, and this at a time of very greatly increased responsibilities with the office at the Royal Society. He never

accepted an appointment without putting his energies into what the various posts demanded.

His outstanding abilities and accomplishments were rewarded by numerous honors, including Companion of the Most Eminent Order of the Indian Empire (C. I. E.), 1906; Knight of the Royal Swedish Order of the Polar Star, 1908; Companion of the Most Distinguished Order of Saint Michael and Saint George (C. M. G.), 1912; Knight Bachelor, 1912; Commander of the Order of Leopold II, 1919; Barclay Memorial Medal, Royal Asiatic Society of Bengal, 1909; Victoria Medal of Honour, Royal Horticultural Society, 1912; Linnean Medal of the Linnean Society, 1935; Albert Medal, Royal Society of Arts, 1925, with memberships in some sixty societies all over the world, including the American Philosophical Society, 1917. He served as President of the Linnean Society, 1916-1919, and was the recipient of the LL.D. degree from Aberdeen (1900), and St. Andrews (1911).

He died in his eighty-sixth year at Whyteleaf, Surrey, on March 16, 1944.

Sir David Prain was an eminently friendly individual, often going out of his way to assist novices and beginners. In the early [383] years of my Philippine experience, a copy of my first paper was, in routine, sent to the library of the Royal Botanic Garden at Calcutta. It happened to have a terminal bibliography, those items not available in Manila being marked by an asterisk. In scanning this, Prain noted that the important *Annals of the Royal Botanic Garden, Calcutta,* was in the starred list. He immediately wrote me a personal letter, stating that if the Governor-General of the Philippines would send an official request to the Governor of Bengal asking that a set of the *Annals* be supplied to the Manila library, that he (Prain) would endorse the request favorably when it came to his desk. Naturally, with such a courtesy shown to a mere tyro, I was at an early date most favorably prejudiced toward Lieutenant Colonel, later Sir David Prain. Years later in conversation with him I reminded him of this episode, and during the conversation, touching on various subjects, he casually remarked that on one occasion when Dr. Melchior Treub, Director of the Botanic Garden at Buitenzorg, Java, was his house guest for a fortnight in Calcutta, the subject of botany was neither mentioned nor discussed during the entire period; both men were outstanding botanists, both very keenly interested in a wide range of botanical problems, and yet their outside interests were so broad that these alone sufficed as subjects of conversation over the two weeks period, rather than subjects within their own special fields.

—XXII—

IN DEFENSE OF THE VALIDITY OF WILLIAM BARTRAM'S BINOMIALS*[1]

[10] But for the fact that various references in Rafinesque's numerous botanical papers which were under examination in connection with the preparation of an "Index Rafinesquianus" involved me in an examination of Bartram's "Travels", it is highly probable that this paper would not have been prepared. Normally, like Professor Fernald, I probably should tacitly have accepted Dr. Rickett's[2] conclusions regarding the non-validity of Bartram's binomials, and thought no more about the matter. However, in connection with Rafinesque's reference to Bartram, I found it essential to prepare an index to the technical names of plants used by the latter. While a number of the Bartram names were accepted soon after they were published and have been recognized by all botanists as valid, many others have consistently been overlooked. A high percentage of those that were entered in our standard indices have either incomplete or erroneous references. With this background, and after a rather critical examination of the compiled Bartram data I am personally convinced that, whether we like it or not, we must continue to consider Bartram's Travels as a legitimate source of properly published binomials in botany. . . .

[11] There are only two botanical entries in the entire work where species are described by Latin phrases, without a binomial. One is "Ipomea, caule erecto, ramoso, tripedali, fol. radicalibus . . ." p. 376, yet elsewhere in the book we note the entry "Ipomea erecta", p. 59, from which

* E. D. MERRILL, "In Defense of the Validity of William Bartram's Binomials" (Bartonia, No. 23, 1943-1944, pp. 10-21, p. p. mai., November 1945).

[1] EDITOR'S NOTE.—Because William Bartram (1739-1823) was a Philadelphian it seems appropriate that this discussion of the Latin names of plants that appeared in his classic "Travels through North & South Carolina, Georgia, East & West Florida, the Cherokee Country, the extensive territories of the Muscogulges, or Creek Confederacy, and the country of the Chactaws; containing an account of the soil and natural productions of those regions, together with observations on the manners of the Indians", first published in Philadelphia in 1791, should appear in our journal. William Bartram was traveling from 1773 to 1777, and so returned to our city after the Revolutionary War had begun; by the time peace was made both his English patron, Dr. John Fothergill (1712-80), and the botanist who was to have identified his plants, Daniel Solander (1736-82), had died. Although William Bartram's specimens duly reached England and are still preserved at the British Museum (Natural History), it is understandable why he never received lists of their names and why in his published "Travels" he mentioned only incidentally the many new species for which he supposed that sometime adequate scientific descriptions would appear abroad. For a recent account of William Bartram, see Dr. Witmer Stone in Bartonia 12S: 20-23, 1931; for a bibliography of works by him and also about him see Dr. John H. Barnhart in Bartonia 12S: 55-66; and for the original report of his travels in Georgia and Florida, with abundant critical annotations, see Dr. Francis Harper in Trans. Amer. Philos. Soc. II, 33; 121-242, pls. 1-26, 1943. In two articles in Bartonia 21: 6-8, 1942, and 22: 3, 1943, Dr. Harper has advocated the adoption of certain neglected names from the "Travels", while in Rhodora 46: 389-391, 1944, Dr. H. W. Rickett of the New York Botanical Garden has opposed that course. Now we welcome a careful consideration of the whole problem by Dr. E. D. Merrill of Harvard University.

[2] **Rickett, H. W.** "Legitimacy of names in Bartram's 'Travels'." Rhodora **46**: 389-391. 1944.

we may assume that it was Bar-[12]tram's *intent* to associate this binomial with the descriptive sentence quoted; there is no cross reference. The other case is "the fantastic Clitoria . . . (Clit. caule volubili, fol. ternatis pennatisque . . .)" p. 243, for neither here nor elsewhere in the volume is there a binomial for this species. Dr. Rickett cites one case with a [Linnaean] binomial followed by a descriptive sentence, in "(Smilax pseudo China; Smilax aspera, fructu nigro, radice nodosa . . .)" where Bartram quotes Sloane's descriptive phrase, either from Sloane's work or from Linnaeus' Species Plantarum 1031. 1753. A more striking case that he did not note is "(Panicum hirtellum, gramen panicum maximum, spica divisa, aristis armatum, Sloan, Jam. Cat. p. 30)", p. 430, for here Bartram deliberately added a binomial, *Panicum hirtellum,* to Sloane's descriptive sentence which is "Gramen paniceum maximum, spica divisa, aristis armatum." Clearly as *Smilax pseudo-china* is the Linnaean binomial, so also is *Panicum hirtellum* a Bartram binomial, even if the former is set off by a semicolon, and the latter by a comma only. I do not consider, as Dr. Rickett does, that the entries "Pinus taeda, foliis geminatis et trinis, . . .", and "Pinus palustris, foliis trinis, . . .", p. 378, "Magnolia pyramidata, foliis ovatis . . .", p. 408, and "Corypha repens, frondibus expansis . . .", p. 61, to be *polynomials,* but rather the first two words of each form the *binomial,* for *Pinus taeda* Linn., *Pinus palustris* Mill., or at least as the latter was interpreted by Walter, *Magnolia pyramidata* Bartr., and *Corypha repens* Bartr. Elsewhere in the work Bartram cites as *binomials,* in *Pinus taeda* seven times, *P. palustris* eight times, *Magnolia pyramidata* once, and *Corypha repens* twice. Another striking case, not cited by Dr. Rickett, is that of *Aesculus,* p. 476; "Aesculus pavia, floribus coccineis, caule suffruticoso, Aesculus sylvatica, floribus ex albo et carneo eleganter variegatis, caule arboreo." We can only assume that here Bartram intended by the first *Aesculus pavia* Linn. to which he added a short descriptive phrase to contrast it with *Aesculus sylvatica* which he proposed as new; elsewhere in his work Bartram cites *Aesculus sylvatica* five times as a binomial without descriptive data. "Stewartia montana, fol. ovatis acuminatis, serratis, flor. nivea, staminum corona fulgida, pericarp. pomum exsuccum, apice acuminato dehiscens," p. 334, is another case in point, for from the binomial *Stewartia montana* a footnote is supplied: "This is a new species of Stewartia, unknown to the European botanists and not mentioned in any catalogues." How is it possible to interpret this long entry as a polynomial when Bartram definitely states that *Stewartia montana,* which he proceeded to describe, is a new species and for which he deliberately published a binomial?

What was Bartram's *intent?* I think that it is clear, from the published record, that he definitely planned to follow the binomial system, for in botany he was thoroughly familiar with this. He was also familiar with Catesby's polynomial names for birds. The transitional period from the pre-Linnaean to the binary system had long since passed when Bartram prepared his text. He [13] cites no less than about 358 different binomials for plants, *as binomials,* some of them listed many times as he observed the same species here and there in his travels; the total, including repetitions, is about 950 as noted above. He accepted those binomials previously published for species with which he was familiar, and incidentally proposed no

less than about 130 new ones for species that were new to him. As some of his binomials were consistently accepted by numerous early authors as far as they were noted, beginning with Willdenow in 1799, I maintain that Bartram should not be penalized at this late date, merely because he lapsed from the binomial system in two cases only as noted above, and apparently in both cases by oversight rather than by intent. Yet the *Ipomoea* case, cited above, is specifically mentioned by Dr. Rickett as indicating that "we can admit no further doubt" as to Bartram's use of polynomials; he probably did not note the entry *Ipomea erecta* on page 59. As to whether or not it was Bartram's intent to follow the binomial system, the entry on page 164 supplies some evidence. In the description of *Cacalia heterophylla* he says: "(Syngenesia Polygamia Oqul. [Aequalis])", here indicating the Linnaean group to which his new species belonged.

It may be noted in passing that when Linnaeus established the binomial system in 1753 he was not wholly consistent, for in the Species Plantarum, we note *Apocynum fol. androsaemi.* Other types of Linnaean specific names that have been objected to are *lachryma jobi, bursa pastoris, unguis cati, coma aurea, linum stellatum* (*Lysimachia*), *trich*[*omanes*] *dentatum, trich*[*omanes*] *ramosum, adiant*[*um*] *nigrum,* and *ruta muraria,* these under *Asplenium, capillus veneris* (*Adiantum*), *f*[*ilix*]*mas, f*[*ilix*] *femina, f*[*ilix*] *fragile,* these under *Polypodium, crista castrensis* (*Hypnum*), *flos aquae* (*Byssus*) and *morsus ranae* (*Hydrocharis*). In the past some of these forms have been simplified as *lachryma, bursa, unguis, morsus,* etc., but in general they are now universally accepted in their original forms. There is no question as to Linnaeus' intent regarding the binomial system.

The argument is advanced that had Bartram intended to publish new binomials he would have indicated them by the use of italics. In no case in the entire work are italics or other special type forms used for either binomials, polynomials, or for binomials associated with descriptive sentences except in "Ixea caelestina" the description of which is published on plate [3] opposite p. 155. Neither are the plant names differentiated in the text of the three English editions, 1792, 1793, and 1794, but they are differentiated by italics or otherwise in the German, Dutch, and French translations. Had Bartram's binomials been set off by use of special type it is probable that more of his new ones would long since have been detected and listed. In these later editions some of Bartram's misspelled technical names are corrected. Bartram very seldom cited the authority for the binomial that he used, whether these be those proposed by earlier authors, such as Linnaeus and Walter, or by himself. Of the 123 new bino-[14] mials proposed by him he very seldom indicated that such names were new, and never cited his own name as the authority. He wrote a book of travel, not a botanical treatise, and like other early authors liberally interspersed in the text the technical names for both plants and animals that he observed; if he were to mention these at all, no other course was available to him, for many of the plants that he observed at that time had no widely used English names.

To me it is evident that in botany Bartram intended to follow the binomial system. Admittedly, the majority of his new names are ***nomina nuda,*** but nevertheless they are binomials. It makes little or no difference whether or not the numerous ***nomina nuda*** be even listed, although names

in this category are rather consistently entered in Index Kewensis. There are about 46 cases where the new names are provided with shorter or longer descriptions or with notes or illustrations whereby identifications might be made, and I hold that these should be accepted; and further that where the species are recognizable, and Bartram's specific names are valid, they should be adopted even if new transfers are involved in a few additional cases. In the zoological field, while his names are for the most part binomials, the percentage of polynomials is slightly higher than in botany. He cites technical names for birds, fishes, and other animals in about 300 cases, and the vast majority of these are in binomial form. I am not in a position to discuss the validity or non-validity of the Bartram binomials in zoology as I am not familiar with the provisions of the zoological code of nomenclature. In any case zoological usage does not effect the status of the botanical names. Messrs. Hubbs, Fowler, Goldman, and F. Harper accept Bartram's binomials in zoology as validly published, while others object to them for one reason or another, and those who do accept them insist that there are no provisions in the zoological code by which they can be eliminated. This is a matter for the zoologists themselves to settle.

Bartram was our first ecologist. He was primarily concerned with writing a readable account of his travels, and this included many descriptions of the various types of vegetation that he observed. His general botanical usage is indicated in the following passages:

"At this rural retirement were assembled a charming circle of mountain vegetables, Magnolia auriculata, Rhododendron ferrugineum, Kalmia latifolia, Robinia montana, Azalea flammula, Rosa paniculata, Calycanthus Floridus, Philadelphus inodorus, perfumed Convalaria majalis, Anemone thalictroides, Anemone hepatica, Erythronium maculatum, Leontice thalictroides, Trillium sessile, Trillium cesnum [cernuum], Cypripedium, Arethuza, Sanguinaria, Viola[,] uvularia, Epigea, Mitchella repens, Stewartia, Halesia, Styrax, Lonicera &c." p. 342, and "Halesia, Stewartia, Aesculus pavia, Aesc. alba, Aesc. Florid. ramis divaricatis, thyrsis grandis, flosculis expansis, incarnatis, Azalea &c. entangled with garlands of Bignonea crucigera, Big. radicans, Big. sempervirens, Glycine frutescens, Lonicera sempervirens &c." p. 401. These are only two of numerous [15] passages of this type in Bartram's Travels, the first passage being merely a list of binomials with a few generic names standing alone, the second a similar one but with one new binomial followed by a short descriptive Latin phrase. To illustrate another type of usage wherein English names of plants, generic names and binomials are involved, a common practice in Bartram's work is: "The forests consist chiefly of Oak, Hickory, Ash, Sour Gum (Nyssa sylvatica), Sweet Gum (Liquid-amber .styraciflua), Beech, Mulberry, Scarlet maple, Black walnut, Dogwood, Cornus Florida, Aesculus pavia, Prunus Indica, Ptelea, and an abundance of Chesnut (Fag. castania) on the hills, with Pinus taeda and Pinus lutea," p. 400. In the above quoted passages, the element of description is mostly absent, and they read like lists of plants in certain types of modern ecological papers.

In contrast to these he sometimes lapses into really descriptive phrases, often distinctly poetic in nature, as: "The pompous Palms of Florida, and glorious Magnolia, strikes us with the sense of dignity and magnificence;

the expansive umbrageous Live-Oak[3] with awful veneration, the Carica papaya, supercilious with all the harmony of beauty and gracefulness; the Lillium superbum represents pride and vanity; Kalmia latifolia and Azalea coccinea, exhibit a perfect show of mirth and gaiety; the Illicium Floridanum, Crinum Floridanum, Convalaria majalis of the Cherokees, and Calycanthus floridus, charm with their beauty and fragrance." Introduction, p. xvi, xvii; "How gently flow thy peaceful floods, O Alatamaha! How sublimely rise to view, on their elevated shores, yon Magnolian groves, from whose tops the surrounding expanse is perfumed, by clouds of incense, blended with the exhaling balm of the Liquid-amber, and odours continually arising from circumambient aromatic groves of Illicium, Myrica, Laurus, and Bignonia," p. 48; "What a beautiful display of vegetation there is before me! seemingly unlimited in extent and variety; how the dew-drops twinkle and play upon the sight, trembling on the tips of the lucid, green savanna, sparkling as the gem that flames on the turban of the Eastern prince; see the pearly tears rolling off the buds of the expanding Granadilla[4]; behold the azure fields of the cerulean Ixea! what can equal the rich golden flowers of the Cana lutea, which ornament the banks of yon serpentine rivulet, meandering over the meadows; the almost endless varieties of the gay Phlox, that enamel the swelling green banks, associated with the purple Verbena corymbosa, Viola, pearly Gnaphalium, and silvery Perdicium, how fantastical looks the libertine Clitoria, mantling the shrubs, on the vistas skirting the groves." p. 155. These graphic word pictures enable even the casual reader to visualize something of what he actually saw and described, and they are in sharp contrast to mere lists of technical names, such as are prepared for the use of botanists only.

[16] Undoubtedly it was Bartram's intent that the new species in his botanical collections should be described by British botanists with whom he was in correspondence, and to whom he sent specimens. Faced as he was with the necessity of using technical names of plants in connection with the fascinating account of his travels, he clearly used those of named species with which he was familiar, and for many of those that were new to him he coined new names, some with shorter or longer descriptions, more as *nomina nuda.* Whether or not we accept his published and described species is more or less beside the point. We must, however, admit, that he did the best that he could under the circumstances, for no author, writing a popular account of his travels could intersperse too many actual technical descriptions of plants and still produce a readable or popular book.

Bartram was inconsistent. Sometimes his binomials are in parentheses, followed or preceded by the descriptions; sometimes the parentheses enclose both the name and the description, but more often they are absent; sometimes the binomial is in the clear and the description is in parentheses. In a number of cases he provided brief Latin diagnoses without supplementary English descriptions, or sometimes supplemented by the latter; again he sometimes provided English descriptions only. Occasionally he published binomials such as *Bartramia bracteata,* p. XVIII, and *Bignonia bracteata,*

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[3] Quercus sempervirens.

[4] Passiflora incarnata, called May-Apple.

p. 468, disassociated with the description of the plant, which in this case appears in the text (without a name), on p. 16 [see infra, p. 23]. He almost never indicated authorities for binomials that he used. There is no differentiation in the text as between his plant names and the general text. In addition to these lapses from what is now assumed to be good botanical usage he not infrequently described species for which, occasionally, he indicates no generic name. Thus for the wild lime or tallow nut, p. 114, no technical name is indicated, his description of which in later years became the whole basis of Rafinesque's monotypic genus *Pimecaria* = *Ximenia* Linn., the species *P. odorata* Raf. = *X. americana* Linn. In other cases he indicated the genus as in the *Aesculus* or *Pavia* sp. which he described on p. 395, this Bartram description later becoming the whole basis of *Macrothyrsus odorata* Raf. Alsogr. Am. 75. 1838 (*Aesculus stolonifera* Raf. l.c., in syn.). In general it is possible accurately to identify most of the entities that Bartram actually described, either from his technical or cursory descriptions, or from appended notes. Here it is, of course, important that the exact localities be considered, for a knowledge of what species grow in certain localities or in certain habitats is not only desirable but essential.

I have accordingly compiled the following data from Bartram, listing all of his new species with their original descriptions, and a supplementary longer list of his *nomina nuda*. About 105 of these names do not appear in our standard indices, but merely because they have been overlooked for a century and a half is no argument against their being at least listed; after all, we do have a [17] homonym rule. Perhaps Dr. Rickett did not note the extraordinary high percentage of unlisted names, or if he did, he perhaps considered that their listing was unnecessary in view of his contention that none of the binomials in Bartram's Travels was validly published. In most of the Bartram names that have been listed there are minor errors in the references, chiefly because most of the entries are to the so-called second edition of his Travels (1794)[5] rather than to the first edition (1791), and there is a slight discrepancy in the pagination of the two following page 48 of the second edition. In at least one case the reference is to the German edition of 1793; in other cases the references are to later works of Michaux, Dumont-Courset, Pursh, de Candolle, Steudel, and other authors who accepted Bartram names.

It is indeed regrettable that so many of the Bartram names have been overlooked for so many years. Personally, however, I prefer to accept the changes that have been made by competent botanists. I defer to such authorities as Small, Pennell, Fernald, and others who in recent years have taken up Bartram names, and no one can criticize the various earlier authors, from Willdenow on, who accepted Bartram's work in good faith. If we eliminate the names in Bartram's Travels for any reason, this merely adds to our difficulties. Thus Dr. Rickett states that *Hydrangea quercifolia* Bartr. may be attributed to Nuttall, Gen. **1**: 284. 1818, but Willdenow accepted the species and provided it with a formal Latin description nineteen years earlier in *Hydrangea quercifolia*, Sp. Pl. **2**: 634. 1799, citing Bartram's illustration from the German edition of 1793.

[5] This 1794 London issue was actually the fourth printing of the book in its original English version, as the first London edition appeared in 1792, followed by the Dublin issue in 1793. These three issues were from the same plates, differing only in the imprint at the bottom of the title pages.

For the most part Willdenow considered only those species that Bartram illustrated, these being *Andromeda pulverulenta, Annona obovata* Willd. (*A. grandiflora* Bart., non Lam.), *Annona pygmea, Hydrangea quercifolia,* and *Ixia coelestina;* he correctly reduced *Magnolia auriculata* Bartr. to the earlier *M. auriculata* Lam. Even if we eliminate Bartram's Travels as the source of accepted names, we do not eliminate the work as one that must be consulted, for in some cases his descriptions of individual species are better than are those of later authors, while his illustrations of plants are excellent. Furthermore, we would be faced with the difficult task of determining what later author first accepted and re-described a Bartram species, whether this be Willdenow, Persoon, Michaux, Roemer & Schultes, Sprengel, Pursh, Nuttall, Elliott, Rafinesque, de Candolle, Chapman, or some other botanist, and unless one makes a really thorough search one may easily go as far astray as did Dr. Rickett in the case of *Hydrangea quercifolia* Bartr. . . .

[19] Regardless of what may be done by systematists as to the acceptance or rejection of the binomials published in Bartram's Travels, many of which were accepted by botanists before the middle of the last century, the book itself should be in every botanical library. It is true that the first edition is now in that very expensive category of a collector's item, and is rarely offered by dealers. The complete original title is "Travels through North & South Carolina, Georgia, East and West Florida, the Cherokee country, the extensive territories of the Muscogulges, or Creek Confederacy, and the country of the Chactaws; containing an account of the soil and natural productions of those regions, together with observations on the manners of the Indians", i-xxxiv. 1-522, frontisp., map, *7 t.* Philadelphia, James & Johnson, 1791. Plate 4 only is numbered. However, a modern facsimile edition is now available in the 1940 reprint.[6]

Professor Lowes notes in his introduction to the 1940 edition that Bartram "exemplified that rarest of combinations—the mind of a scientist with the soul of a poet," briefly mentioning the influence that Bartram had on the English poets Coleridge and Wordsworth. Bartram's rather remarkable influence on literature, which has attracted the attention of various investigators, is extensively discussed by N. B. Fagin, pages 127-203 of his "William Bartram, interpreter of the American landscape", i-vii. 1-229. 1933. See also, J. L. Lowes "The Road to Xanadu" for Bartram's influence on Coleridge's imagery.[7] When issued the [20] book attracted immediate and favorable attention, both at home and abroad. It was republished in London in 1792 and reprinted in Dublin in 1793, and again in London in 1794. The German edition, William Bartram's "Reisen

[6] "The travels of William Bartram." Edited by Mark Van Doren with an introduction by John Livingston Lowes. 1-14, 1-414. 1940. Facsimile Library. Exclusive distributors Barnes & Noble, Inc., New York. This follows the original edition as to content, Bartram's plates not being reproduced, but differs in pagination. Another modern edition is that of Macy-Masius, New York, 1928, 414 pages; this follows the London edition.

[7] The following statement is quoted from Van Wyck Brooks' recent "The World of Washington Irving," 110. 1945: "Numbers of these images, which appeared in Bartram's 'Travels,' reappeared in some of the world's great poems; for when the book was published, in 1791, it opened a new scene for romancers and poets. It passed into the mind of Coleridge, whence it reëmerged in two or three splendid passages in *Kubla Khan.* There one found the jetting fountains and the incense-bearing trees,

durch Nord- und Süd-Karolina, Georgien, Ost- und West-Florida, das Gebiet der Tscherokesen, Krihks und Tschaktahs, nebst umständlichen Nachrichten von den Einwohnern, dem Boden und den Naturprodukten dieser wenig bekannten grossen Länder," appeared in Vienna in 1793 as volumes nineteen and twenty of the Magazin von merkwürdigen neuen Reisebeschreibungen **19:** i-xxxix. [i-ix]. 1-403. *t.* [*1-5*]. 1793; **20:** 1-427. *t.* [*1-2*]. 1793, and was reprinted in single volume format under the same title in Berlin the same year, i-xxvi. 1-469 [501]. *t. 1-7.* 1793. The translation is by E. U. W. Zimmermann. A Dutch edition was issued in Haarlem in 1794 as: "Reizen door Noord- en Zuid-Carolina, Georgia, Oost- en West-Florida: De Landen der Cherokees, der Muscogulges, of het Creek bondgenootschap en het Land der Chactaws." i-xxvi. 1-695. 1794. The translation is by J. D. Pasteur. Bartram's illustrations were not reproduced. It was soon translated into French with two issues, one An VII (1799), the other An IX (1801), as "Voyage dans les parties sud de l'Amérique septentrionale; Savoir; les Carolines septentrionale et méridionale, la Georgie, les Florides orientale at occidentale, le pays des Cherokees, le vaste territoire des Muscogulges ou de la confêderation, et le pays des Chactaws. Contenant des détails sur le sol et les productions naturelles de ces contrées, et des observations sur les moeurs des Sauvages qui les habitent." **1:** 1-457, frontisp., *t. 1-2;* **2:** 1-436, *t. 3.* An VII [1799]. The An IX [1801] issue is a reprint of this. The translation is by P. V. Benoist. And this several decades before the blast of the British reviewer regarding American publications: "Who reads an American book?" . . . but Bartram's fascinating volume was not a work of fiction. In the original Philadelphia edition only plate 4 is actually numbered (in the several copies that I have examined); in the other editions they are all numbered. They are not included in the Dutch edition.

Believing that it is the duty of all taxonomists to call attention to unlisted binomials which are not infrequently noted as one scans both the older and occasionally some of the more recent botanical literature, this with view to making our standard indices ultimately complete, I have checked the Bartram names on both "Index Kewensis" and its Supplements, and on Christensen's "Index Filicum." In the following pages* an asterisk (*) added to a name means that it is unlisted, and the sign † indicates that while the name is listed, the reference is either incomplete or erroneous as to the original place and date of publication. Most of the

together with other reminders of the Isle of Palms; and Bartram's wondrous fishes, attired in blue, red, blue and green, appeared in *The Ancient Mariner* as water-snakes. Wordsworth, too, read the book, and these pictures of the tropical forest passed into his poems, the green savannahs, the endless lakes, the fair trees, the gorgeous flowers, the magnolias, the azaleas that 'set the hills on fire' in *Ruth.* There one found the Indian maidens gathering strawberries in the wood, while Wordsworth's *Prelude* also bore traces of Bartram. Campbell's *Gertrude of Wyoming* was full of scenes from Bartram, and more than fifty pages of Chateaubriand's *Les Natchez* were drawn directly from his pages", and in a footnote from this passage: "When Coleridge and Southey, reading Bartram, thought for a while of leaving England in order to live on the banks of the Susquehanna, they took it for granted that they would find there the scenery, flowers and birds of Florida. Thus Campbell, in *Gertrude of Wyoming,* which was based largely on Bartram, placed 'hills with high magnolia,' broad savannahs and the meteor-like flamingo in a valley that was also on the Susquehanna."

* [Not reprinted.]

entries that are included in Index Kewensis are to the London issue of 1794, the first London edition being that of 1792, rather than to the original Philadelphia edition of 1791. This actual listing of overlooked or erroneously cited binomials is of real importance and value to all systematists, for until published names are actually included in standard indices of the type mentioned, [21] they generally remain in that limbo of overlooked ones where the conservatives would be only too pleased if they there stayed indefinitely. However, whether or not we elect to accept a Bartram name, as noted above, we do have a homonym rule, and this rule alone should justify the listing of all published binomials. Had all of the Bartram names been listed at an earlier date, we would probably not, a century and a half after the book was published, be faced with the problem of accepting the valid ones and replacing specific names long used for this or that species; and maybe the question as to the validity or non-validity of Bartram's book as a source of binomials would not have been raised. Including strictly *nomina nuda* there are about 110 previously unlisted Bartram binomials, and about 8 minor corrections to be made to binomial entries that are listed in "Index Kewensis."

In preparing the following lists,* I have, where descriptions or notes are concerned, quoted from the first Philadelphia edition of 1791. I have not concerned myself with minor variants in the spelling of technical names, such as Sideroxilon, Hybiscus, Euonismus (*Euonymus*), Acher (*Acer*), Sambricus (*Sambucus*), Drossea (*Drosera*), Halmea (*Kalmia*), Lantana Camerara, Laurus sasafras, Nymphaea nilumbo, Populus trimula, Pinus toeda, Trillium cesnum, Halesia taetraptera, etc., for such variants with occasionaly badly misspelled specific names such as ruelgare for *vulgare,* and usneascites, and ulneadscites for *usneoides,* are not uncommon in the text. These errors were due to inadequate proof reading or to the slips of the pen. The critical reader will also note various false binomials that I have deliberately ignored, such as "Cercis tilia [Cercis, Tilia]" p. 28, "Itea stuartia [Itea, Stuartia]" p. 10, "Itea Clethra [Itea, Clethra]" p. 24, "Callicarpa Johnsonia [Callicarpa, Johnsonia]" p. 164, "Morus tilia [Morus, Tilia]" p. 221, and "Viola uvularia [Viola, Uvularia]" p. 242. These were inadvertent errors of a typographical nature and there is no warrant in listing them.

Any reader interested in following up Bartram's routes more closely, should study William Bartram's "Travels in Georgia and Florida, 1773-74: a report to Dr. John Fothergill," annotated by Francis Harper, in Trans. Am. Philos. Soc. II. **33**(2): 121-242. *t. 1-26.* 1943, for this forms an excellent supplement to Bartram's "Travels." I am under obligation to Dr. Harper who supplied various suggestions to me for the improvement of this paper, and especially for his courtesy in determining the exact places in which Bartram observed the species that he characterized as new.

In general, in this consideration of Bartram's binomials wherever he recorded a name that was published by Linnaeus, Walter, or other authors before 1790, for plants native of eastern North America, I have assumed that he correctly interpreted the species to which these names appertain. The remaining binomials were originated by Bartram. The number of these new Bartram binomials, about 130, is much larger than was anticipated before the lists were checked. . . .

* [Not reprinted.]

— XXIII —

FURTHER NOTES ON TOBACCO IN NEW GUINEA*

[22] In 1930 I published a short paper on tobacco in New Guinea[1] in which I took exception to the more or less current belief among ethnologists, and apparently among some botanists, that tobacco was known to the aborigines of New Guinea long before the arrival of Europeans in the region, and also to the belief expressed by some ethnologists that the smoking of tobacco originated independently in New Guinea, perhaps on the basis of a native species of *Nicotiana.* I noted that apparently this myth or series of myths originated with Dr. O. Finsch, in 1886. However up to 1930 only a single species of *Nicotiana* (*N. tabacum*) was known from New Guinea, and the very extensive field work that has been prosecuted there since that date has failed to extend the list. All botanists and collectors who have considered the matter, that is, those that have actually been engaged in the exploration of New Guinea, insist that only a single species of *Nicotiana* occurs there, that this is always a cultivated plant, and that it is the common tobacco, *Nicotiana tabacum.* This is, of course, a species of American origin, but it may now be emphasized that it is definitely of hybrid origin. It is a cultigen, belonging in the same category as maize, in that for its existence it is largely dependent on man, having lost the ability to maintain itself in nature.

We now have access to the results of Dr. Lam's trip up the Mamberamo River to the central mountain range of Netherlands New Guinea, based on a full year of field work, and I have handled all of the extensive botanical collections made by Mr. L. J. Brass on the three Richard Archbold Expeditions, first in southeastern New Guinea from the coast to the summit of the Owen Stanley Range, second up the Fly River, and third from Hollandia to the central mountain range of Netherlands New Guinea. The total of the Brass collections approximates 10,500 numbers. Dr. Lam, in his year's experience in the field, saw only cultivated *Nicotiana tabacum,* and Mr. Brass encountered only forms of that species, some at low altitudes, and one from a relatively high altitude.[2] I have also had access to a partial set of the large Carr collection made in southeastern New Guinea, the Kanehira collections made in Netherlands New Guinea, and an extensive series of specimens collected by Mrs. Clemens in Northeastern New Guinea (German New Guinea), all made since 1930. All observers are in agreement that tobacco in New Guinea occurs only in cultivation, that its leaves form an important item in inter-tribal commerce, [23] and that cultivation occurs at both low and high altitudes where proper climatic and soil conditions permit. It is even found in cultivation among the primitive stone-age

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* E. D. Merrill, "Further Notes on Tobacco in New Guinea" (American Anthropologist 48:22-30, 1946).

[1] Merrill, 1930. (See bibliography at end of article.)

[2] The highest-altitude tobacco collected by Mr. Brass was his number 11394 from the Bele River, 18 km. northeast of Lake Habbema, at an altitude of 2,200 m., his note bearing the statement "cultivated by the Pesegem tribe." This is a form with relatively small, narrow, lanceolate, petioled leaves. It is a form of *Nicotiana tabacum* Linn.

aborigines (the Pesegem and the Timorini) who inhabit the high and very remote interior valleys.

Dr. Lam reports that the Timorinese name for tobacco is *tabo* and that the term for the pipe is *tabaok,* and he correctly surmises that these were derived from the Malay *tabako.* The word is of American (Caribbean) origin and originally was applied to the cigar,[3] rather than to the plant. Like such names as tea and coffee the name *tobacco,* variously modified, was disseminated with the plant or its product to all parts of the world, and like tea and coffee this dissemination was modern and not ancient; that is, modern in the sense that the spread of the plants, their names, and their products followed the time of the discovery of America and the expansion of the European colonizing nations. Dr. Lam inferred, correctly in my opinion, that the occurrence of these names, *tabo* and *tabaok,* among the Timorini is an indication that the plant, with the name, reached the isolated interior primitive people of New Guinea through direct or indirect contact with the Malays. The Pesegem use *mbali* for tobacco and *kanoem* for the pipe. Dr. Lam cites Van Nouhuys' report that tobacco was not known by the tribes along the lower course of the Lorentz River, but only by the Pesegem, and notes the fact that *Nicotiana tabacum* is widespread in New Guinea.

Recently in checking certain botanical references in connection with our New Guinea plant studies, I noted a significant statement regarding tobacco in New Guinea, based on observations made between 1871 and 1877, and actually published in 1886, the same year that Finsch's unfortunate conclusions appeared. This statement is of so much interest that it is quoted in full below. From an examination of it one will readily perceive that the smoking of tobacco is clearly not ancient in New Guinea, and that we may safely infer that the practice was introduced by the white man, in relatively modern times, together with the plant itself, that in New Guinea the use of tobacco proceeded from the west to the east, and that it reached eastern New Guinea in the nineteenth century.

It is admitted that some botanists have reached conclusions corresponding to those of certain ethnologists regarding the occurrence of tobacco in some parts of the Old World in pre-Columbian times. Thus Dr. A. Chevalier[4] in 1927, perhaps misled by certain anthropological dogmas, concluded that the peoples of the southwestern Pacific region and those of southeastern Asia knew tobacco and the sweet potato long before the discovery of America by Colum-[24]bus. Dr. H. Lam[5] discusses Chevalier's conclusions, taking a conservative attitude:

> These and other cultivated plants, according to Chevalier, through the agency of

[3] *Editor's note:* The general literature usually states that the original word *tabaco* referred to *pipe.* This is incorrect; pipes were unknown in the Antilles. (See J. A. Mason, *Use of Tobacco in Mexico and South America,* Field Museum of Natural History Leaflet 16, 1924.)

[4] Chevalier, 1927.

[5] Lam, 1945, pp. 148-149. This is an English translation, by Dr. L. M. Perry, of the original Fragmenta Papuana, which was published in the Dutch language in the Natuurkundig Tijdschrift voor Nederlandsch-Indië, vol. 87 (1927) to vol. 89 (1929). It contains many data of interest to anthropologists and ethnologists regarding the primitive stone-age peoples who inhabit the high remote valleys of the interior of New Guinea, and their culture, particularly the Timorini and the Pesegem.

man, perhaps also by birds, and even on driftwood, might have extended via the numerous islands of the Pacific Ocean far to the west. I suppose that here [New Guinea] in particular the influence of man must be considered. Tobacco was first introduced into Java by the Dutch in 1601, but one might assume that it was known much earlier in the Moluccas and seemingly also in New Guinea. Van Nouhuys informs me that, from old travel records, it is apparent to him that tobacco occurred in Ternate in 1599, and that slaves (Papuans?) especially used it.

We know definitely that Rumphius was familiar with tobacco in Amboina between 1670 and 1690. Personally I do not think that we have to go back of the Portuguese colonization of Amboina in 1521 to account for the presence of tobacco in the Moluccas, and presumably also in New Guinea, before it was introduced into Java. After all, Van Nouhuys' date, 1599 for Ternate, is only two years before tobacco was introduced into Java and is nearly ninety years after the Portuguese actually reached Amboina, and seventy-eight years after they established a permanent settlement there.

It is a rather widely accepted belief that the sweet potato occurred in Polynesia and as far to the southwest as New Zealand long before the Europeans crossed the Pacific Ocean, the date of Magellan's arrival in the Philippines being 1521. If this important food plant did reach the above regions before the Magellan date one might expect that it may also have reached New Guinea. I have found no references that lead me to believe that the sweet potato reached any part of Papuasia, Malaysia or tropical Asia before the arrival of the Europeans. As to its early introduction into Polynesia and New Zealand see Messrs. Dixon[6] and Buck[7] *pro* and Friederici[8] *contra.*

Perhaps individuals may be impressed by the relatively large number of different local names applied by aboriginal peoples to manifestly introduced species. Yet these names should be used with caution when such data are utilized to support a theory of early introduction. It is clear that in many places native people have coined their own names on a distinctly large scale for certain introduced species which perhaps came to them without names, and yet soon became widely distributed in cultivation.

The situation in New Guinea with its numerous languages and dialects is [25] peculiar. Miss Henriette Neuhaus of New York compiled for me the recorded native names for certain widely cultivated species in eastern New Guinea, including the yam, tobacco, and the sweet potato, from the annual reports of the Territory of Papua = British New Guinea, 1886-1927. Thus for tobacco, in excess of one hundred different names are listed as used in the Territory of New Guinea alone, with an even larger number of different names for the sweet potato. Clearly some of these names were based on those introduced by the Europeans, but in both cases the vast majority of them, to me at least, suggest no genetic relationship with names transmitted through Europeans.

For tobacco, by far the most widely used one, listed about sixty times, is *kuku,* this sometimes indicated as a trade name. But names apparently derived from tobacco include *bakuki, kamake, tabake, tabaken, tabaoak, tafaki, tampili, tapaki, tapai-e, taubaki, tobaki, tobako,* and *topako,* probably

[6] Dixon, 1932.

[7] Buck, 1938, pp. 313-316.

[8] Friederici, 1929 (see long review by H. Damm, Ethnol. Anz. 3: Referate 64-68, 1933), 1931, 1936.

also *sakaba, sakapa, sakopa, sakupa, sekupe, sikube, sokuba, suguba, sukaba,* and doubtless others in the compiled list.

The variations in the names of the sweet potato and the yam, both, like tobacco, introduced plants in New Guinea, are just as striking, as is the case with the names of tobacco. The yam, being of Old World origin, was unquestionably of prehistoric introduction into New Guinea. Tobacco, certainly, and I believe the sweet potato, also represent introductions from tropical America in post-Magellan times. The New Guinea sweet-potato names are even more variable than are those of the tobacco, ranging from *atari* to *yembilyamagini,* with those most frequently recorded being *nai, kupe* and variants, *kaire, kailikuta, kanua, mosera,* and *nori.* It is of interest to note that the Quechua name, *kumara,* is recorded but twice, but some of the listed forms may have been derived from it.

Variants in the name *kumara* as actually used in the Pacific islands include the following: *gumalla* (Tahiti), *gumarra* (Tahiti), *kuma'a* (Marquesas), *kumala* (Fiji), *kumara* (Marquesas, Easter, Niue, Fiji, Rarotonga, New Zealand, New Guinea), *timala* (Niue), *uala* (Hawaii), *uma'a* (Marquesas), *umala* (Samoa), and *umara* (Tahiti, Austral Islands). Within Polynesia the name for the sweet potato seems consistently to have been derived from the Quechua *kumara.* The Spanish introduction of the species into the Orient from Mexico carried the Nahuatl name *camote,* this being the almost universal name for the species throughout the Philippines, and in Guam with such minor variants as *kamute* (Guam), *kamott* (Yap), and *kamolo* (Marshall Islands).

I am not unduly impressed by Friederici's statement, quoted below, insofar as possible Spanish introductions into the Solomon Islands, Santa Cruz, and the New Hebrides are concerned, for the simple reason that the early Spanish attempts to colonize those islands were abortive.

Friederici states:[9]

> Hierzu gehört in erster Linie die Süsskartoffel. Ich habe nachzuweisen versucht [26] [footnote reference to Anthropos 24 (1929)], dass die Ipomoea Batatas Poir. nicht, wie bisher angenommen wurde, von den Südseeinseln aus nach Amerika kam, sondern dass vielmehr die in der Alten Welt bisher bekannte Batate von den Spaniern unter Mendaña [1595] und Quirós [1605] aus Amerika, wo sie altes alteinheimisches Kulturgewächs war, nach den Marquisas, den Solomonen, Santa Cruz- und Banks-Inseln und nach den Neuen Hebriden gebracht worden ist.

Clearly the wide use of the Quechua name *kumara* of Peruvian origin in Polynesia has impressed various individuals in favor of the idea that the plant with its name was a pre-Magellan introduction into Polynesia, for this name with minor variants occurs all the way from Marquesas and Hawaii to New Zealand and even New Guinea, and the first European explorers of New Zealand found the plant in cultivation there under that name.

It is true that the Spaniards did discover the Solomon and Santa Cruz Islands at an early date, but they were not exploited. In fact for a period of two hundred years after the Solomon Islands were discovered the very existence of the group was doubted. Gallego sailed from Callao in 1566 and returned to South America in 1568, after exploring the Solomon group, but for some reason his journal was suppressed. It is now fortunately avail-

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[9] Friederici, 1931, p. 140.

able in Guppy's[10] translation. To me the interesting point in this old narrative is that it is absolutely negative as to the occurrence of the sweet potato in the Solomons in the sixteenth century. Gallego does mention various plant foods that were brought to them by the natives, including *mames* or *names* and *panoes* or *panales*. The first was probably his name for the yam (*Dioscorea alata*), but Mr. L. J. Brass suggests a species of *Canarium* now known as *nali*, the seeds of which are very widely used for food in the Solomon Islands. From the context in Gallego's account one suspects that a root crop was involved. By *panoes* or *panales* Gallego manifestly was using not native names but some Spanish dialectal name for a European root crop, applied by him in the Solomons to the corms of the taro (*Colocasia esculenta*). There is no mention of the sweet potato. It may be assumed that, sailing as he did from Callao, he would have been familiar with the plant and with its Quechua name *kumara*.

Mendaña and Quirós did make a serious attempt to colonize the Solomons, sailing from Peru in 1595, in the course of this voyage discovering the Marquesas Islands. The expedition failed to reach Solomon Islands, but did discover the Santa Cruz group. The attempt to establish a colony there failed, and after only two months the colonists left for Manila, with perhaps half of the original party of four hundred, which included both men and women, reaching that haven. Quirós' attempt in 1605 was just as abortive, for he never reached the Solomons, nor the Santa Cruz Islands, although he was in the vicinity of both groups. As both the Mendaña-Quirós and the later Quirós [27] attempts were for colonization purposes it may logically be assumed that they were supplied with seeds and perhaps living plants of certain food-producing species, yet it is improbable, due to the short period of colonization involved, that they could have established such a species as the sweet potato in the island groups of the southwestern Pacific region that they visited.

If the sweet potato did reach the Pacific Islands in Pre-Magellan times it could have been transmitted from America only by man, as it is not propagated by seeds, and in the tropics its tubers decay, under normal conditions, within a relatively short time. It may be that when it was introduced into Polynesia it may have been confused with the yam (*Dioscorea*), which the early Polynesians certainly did have, whether the introduction of the former be early or late. The sweet potato, once introduced, usually tends to dominate the yam in cultivation because of its superior qualities; and in some regions we know that aboriginal names of the yam, such as *úbi*, were applied here and there to the sweet potato after the latter was introduced within post-Magellan times. Dr. Buck states that the sweet potato was in Hawaii by 1250 A.D., and in New Zealand by 1350 A.D.

I am afraid that in some cases individual authors may be accused of wishful thinking in that, at least in some cases, they have set up preconceived theories and have presented the data that supported a theory, ignoring those that are opposed to it. To be classed in this category are certain papers of O. F. Cook,[11] whose conclusions have been shown to be utterly erroneous.

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[10] Guppy, 1887, pp. 102-245.

[11] Cook, 1901, 1910; Cook, O. F., & R. C. Cook, 1918. For data opposed to Cook's ideas see Beccari, O. Origin and Dispersal of Cocos nucifera. Philip. Jour. Sci. 12:

The flotsam and jetsam idea as expressed by some to explain presumed early pantropic distribution of certain economic cultivated plant species through the medium of driftwood is so patently erroneous as to be somewhat humorous. The number of strand species that are of universal pantropic distribution is surprisingly small, and is confined to representatives of various families where the seeds float for indefinite periods in salt water and yet retain their viability. Not one of the numerous cultivated species falls in this category. Their seeds cannot withstand immersion in either salt or fresh water for more than a few days and still retain their viability, and few of them will even float. One has only to consider the seeds of such common species as the various cultivated cereals, beans, peas, cruciferous plants and others to realize their limitations. When this flotsam idea is applied to such a species as tobacco, a plant that for its continued existence, like maize, is dependent on man, one reaches the height of absurdity in postulating the driftwood idea.

[28] Elsewhere I have discussed the problem of Polynesian weeds,[12] showing rather conclusively, on the basis of the botanical record, that there are two categories. The first includes those "Polynesian" weeds, that is, the relatively few species that were known to occur in Polynesia before 1782, and the second the very much larger number that have been introduced since that date. Most of those in the first category are definitely of Old World origin and represent early accidental introductions in Polynesia by the Polynesians themselves. In passing, Dr. Lam discusses the ruderal species (weeds) noted by him in the interior of New Guinea and comments on the relative paucity of such species in the paper referred to above. The second and much larger category represents the numerous species that have been introduced into Polynesia within the past 150 years. While some of these are of Old World origin, the vast majority of them came from America. My interpretation of the "Polynesian" weeds, i. e., the early introduced ones, was based on an examination of the Solander lists which in turn were based on the plants collected on Cook's voyages, 1769-82, these being the first botanical collections made in Polynesia.

This first category indicates little or no possible connection between Polynesia and America in early times. If there be a very few weeds of American origin in the early Solander lists, this is understandable because a great many early European exploring expeditions traversed the Pacific following 1521, these for the most part coming via the Straits of Magellan and the west coast of South, Central, and North America. It would be most surprising if the seeds of a few American weeds were not transmitted to various Polynesian islands in this period, for we know that a very considerable number of aggressive American weeds were introduced into Guam and into the Philippines through the intermediary of the Acapulco-Manila galleons between the latter part of the sixteenth century and the year 1815.

27-43, 1917; Chiovenda, E. La culla del cocco. Contributio alla ricerca della patria originaria della palma di cocco. Webbia 5: 199-294, 1921; 359-449, 1923; and Merrill, E. D. Comments on Cook's Theory as to the American Origin and Prehistoric Distribution of Certain Economic Plants, Especially Hibiscus tiliaceus Linn. Philip. Jour. Sci. 17: 377-384, 1920.

[12] Merrill, 1941.

The de Miklouho-Maclay[13] observations that recently attracted my attention were made at Garagassi (1871-72) and Bongu (1876-77), near Port Constantine, in eastern New Guinea. The passage regarding the occurrence of tobacco in New Guinea, and one that, in my opinion, refutes the rather widely accepted conclusions of Finsch and others, is as follows:

"*Nicotiana tabacum* (*Kas*). The old natives of this Coast remember, that they were told by their fathers, that in their youth they (the fathers) were not acquainted with the use of tobacco and that the seeds and the knowledge of smoking have been introduced and have spread from village to village from the west. There are some villages in the mountains of the Maclay-Coast where the custom of smoking has not been introduced (1). The dried tobacco leaves are, before smoking, dried on a fire, after which they are torn, crushed and rolled in a leaf (2), also previously dried on fire, in the shape of a big cigarette and smoked. In some hill villages, the natives have large bamboo pipes (3), which [29] are filled with tobacco smoke from a cigarette and smoked by many people in turn, everyone trying to inhale and to swallow as much of the cold smoke as he can. The use of the pipe has not been adopted by the coast natives, who prefer to smoke cigarettes."

The footnotes by Baron Ferdinand von Mueller, the eminent Australian botanist, are:

"(1) The use of tobacco in the Louisiade Archipelago has been introduced quite lately. I visited in 1880 some hill villages on the Island Basilaki (or Moresby Island) where the natives were completely unacquainted with tobacco and smoking." (The Louisiade Archipelago is off the eastern end of New Guinea.)

"(2) The natives of the Maclay-Coast use the leaves of several plants as covering for their cigarettes. I am sorry however to say, that I have neglected to ascertain which are these special plants.".

"(3) Just like on the South-Coast of New Guinea, where the use of tobacco, according to the authority of Rev. Lawes, has been introduced from the West and only lately has spread gradually to the S. East extremity of New Guinea and now the *kuku* (the native name for tobacco on the S. E. Coast of New Guinea) is in the greatest demand."

I can only infer from these statements, made by thoroughly competent observers somewhat earlier than Finsch's conclusions were published, that the growing and use of tobacco in New Guinea proceeded from the west to the east, which is exactly what would be expected if, as I believe, the Portuguese first introduced tobacco into the Moluccas, following the period of their establishment of a permanent settlement at Amboina in 1521. Amboina is not far from the west end of New Guinea. The idea that the use of tobacco in New Guinea may have been based on a native species is definitely erroneous, for no native species of the genus occurs in the island. Were Finsch correct in his belief regarding a much earlier introduction of tobacco into New Guinea via the Pacific islands in pre-Magellan times, then logically we would expect that its use there would have proceeded from east to west, and again, would it not be strange indeed if its use persisted in New Guinea, and yet became absolutely lost to the Polynesians?

[13] de Miklouho-Maclay, 1886.

No early explorer of Polynesia mentions either tobacco or its use in Polynesia. Had tobacco been known in New Guinea "from time immemorial" one could only conclude that its use there would have been universal long before 1871-72, yet according to Van Nouhuys, as to some parts of New Guinea, it was unknown well into the present century. Thus there seems to be no reason for perpetuating the expressed belief on the part of some authors that tobacco occurred in New Guinea long before the Europeans arrived in the Pacific region, or that the art of smoking originated independently there. One concludes that it was the hardy European sailor who disseminated the tobacco-smoking habit, and that somewhat later, enterprising tradesmen actu-[30]ally introduced the plant into cultivation here and there in the orient with an eye to potential profits; for the smoking habit, once established, made tobacco a very potent article of exchange in bartering with primitive peoples. This conclusion may be in the nature of an anthropological or ethnological heresy, but it is the only one that I as a botanist can draw.

BIBLIOGRAPHY

Buck, Peter H.
1938 *Vikings of the Sunrise.* New York.
Chevalier, A.
1927 *Les origines du tabac et les débuts de sa culture dans le monde.* Revue Internationale des Tabacs, 4, pp. 13-16.
Cook, O. F.
1901 *The Origin and Distribution of the Coconut.* Contributions from the U. S. National Herbarium, 7, pp. 257-293.
1910 *History of the Coconut Palm in America. Idem,* 14, pp. 271-342.
Cook, O. F., and R. C. Cook
1918 *The Maho or Mahagua as a Trans-Pacific Plant.* Journal of the Washington Academy of Science, 8, pp. 153-170.
Dixon, R. B.
1932 *The Problem of the Sweet Potato in Polynesia.* American Anthropologist, 34, No. 1, pp. 40-66.
Friederici, G.
1929 *Zu den vorkolumbischen Verbindungen der Südsee-Völker mit Amerika.* Anthropos, 24, pp. 441-487.
1931 *Veränderungen in der Südseekultur seit der Zeit Mendanas.* Petermanns Mitteilungen, 77, pp. 138-143.
1936 *Die Süsskartoffel in der Südsee.* Mitteilungsblatt der Gesellschaft für Völkerkunde, 7, pp. 2-7. Leipzig.
Guppy, H. B.
1887 *The Solomon Islands and Their Natives.* London.
Lam, H.
1945 *Fragmenta Papuana [Observations of a Naturalist in Netherlands New Guinea].* Sargentia, 5, pp. 1-196, 32 figs., 2 maps.
Merrill, E. D.
1930 *Tobacco in New Guinea.* American Anthropologist, 32, No.1, pp. 101-105.
1941 *Man's Influence on the Vegetation of Polynesia with Special Reference to Introduced Species.* Proceedings of the Sixth Pacific Scientific Congress, 4, pp. 629-639.
Miklouho-Maclay, A. de
1886 *List of Plants in Use by the Natives of the Maclay-Coast, New Guinea (with Botanical Remarks by Baron Ferd. von Mueller).* Proceedings of the Linn. Society, N. S. Wales, 10, pp. 346-354.

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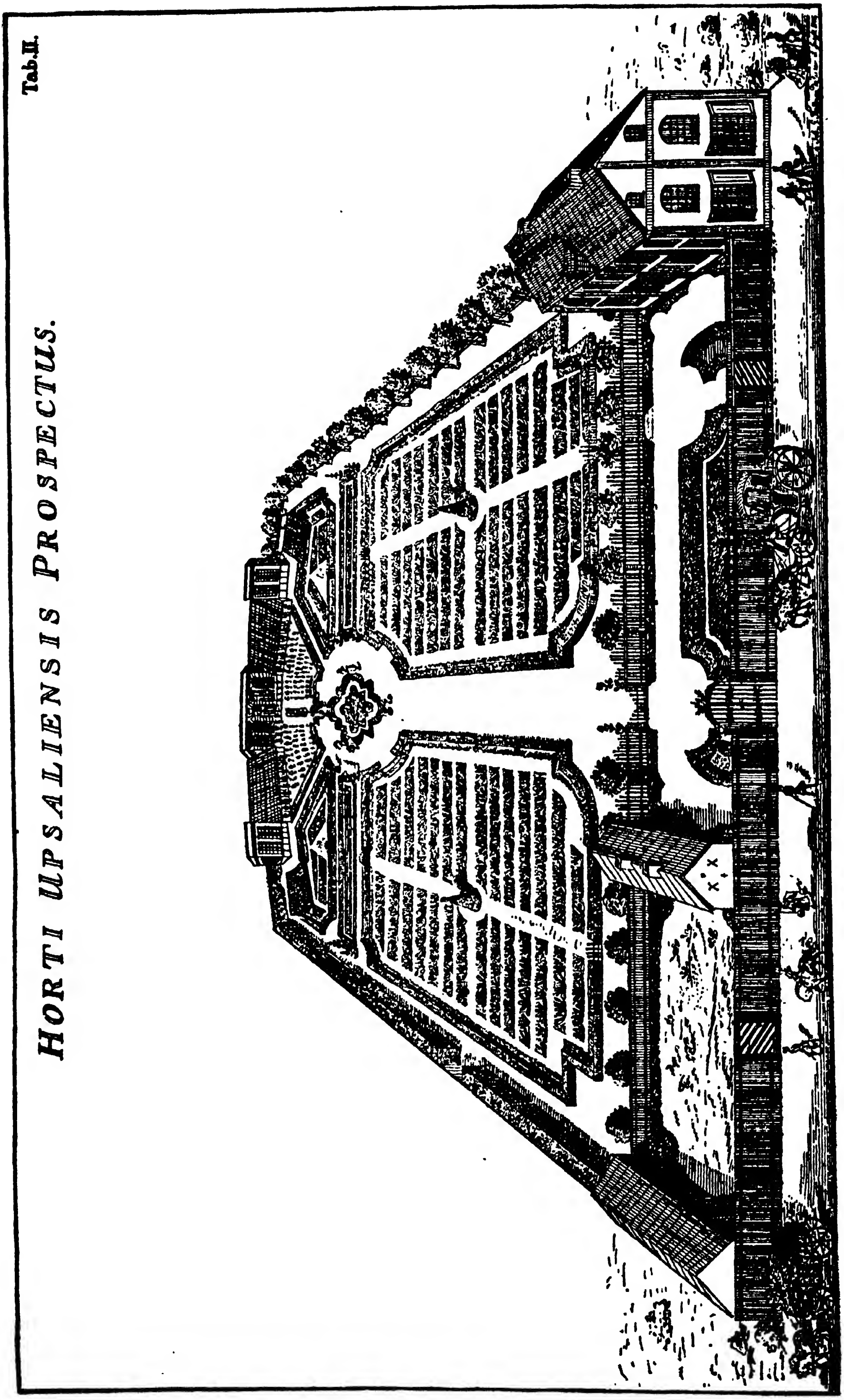
The ARBORETUMS and BOTANICAL GARDENS of NORTH AMERICA



CAROLUS LINNAEUS' FAMOUS 'TRÄDGÅRD', the *Hortus Botanicus* of Uppsala, Sweden, for several decades the botanical center of the world, after the plate in the author's *Hortus Upsaliensis* (1745; reprinted in Swedish in *Skrifter*, vol. 4, 1908).

The ARBORETUMS and BOTANICAL GARDENS of NORTH AMERICA

by

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CONTENTS *and* ILLUSTRATIONS

EDITOR'S FOREWORD

Though we have always made an effort in the columns of CHRONICA BOTANICA to report well on the botanical gardens and arboretums in various parts of the world, we have never been able to present such a detailed report as Dr. WYMAN's account of the arboretums and botanical gardens of North America, which we are glad to bring in this issue of our CHRONICA. This report, prepared under the auspices of the American Association of Botanical Gardens and Arboretums, will be useful and stimulating to plant scientists and plant lovers all over the world. We hope that it may be possible, before long, to issue a similar account of the botanic gardens and arboretums in other parts of the world. The botanical garden idea is old; it goes back almost to the dawn of human civilization. In the early Renaissance the botanical gardens entered a new cycle of development; and in very recent times, a number of new possibilities, about which this booklet reports so well, have been proposed, indicating that we may be entering another new cycle in the development of our *herbaria viva.*

For a long time I have been interested in the development of botanical gardens, a knowledge which is necessary for the proper understanding of their functions and future. I have gathered much literature, references and prints dealing with this fascinating subject, and I appreciate Dr. WYMAN's permission to include some of the historical prints from the Arnold Arboretum and Chronica Botanica collections in his report.

Too little seems known about the early botanical gardens of North America. WEBB in his Bachelor's Hall describes a botanical garden, supposedly belonging to JAMES LOGAN, the well-known Colonial statesman and botanist:

> "Close to the dome a garden shall be joined
> A fit employment for a studious mind;
> In our vast woods whatever simples grow,
> Whose virtues none, or none but Indians know,
> Within the confines of this garden brought,
> To rise with added lustre shall be taught;
> Then culled with judgment, each shall yield its juice,
> Saliferous balsam to the sick man's use . . ."

As early as 1767 SOLOMON DROWN of Rhode Island, noted in his diary: [Near Providence I visited] "Mr. REDWOOD's Garden . . . one of the finest gardens I ever saw in my life. In it grows all sorts of West Indian fruits, viz.: Oranges, Lemons, Limes, Pineapples, and Tamarinds and other sorts. It has also West India flowers—very pretty ones—and a fine summer house. It was told my father that his garden was worth 40 thousand pounds, and that the man that took care of the garden had above 100 dollars per annum. It had Hot Houses where things that are tender are put for the winter, and hot beds for the West India Fruit. I saw one or two of these gardens in coming from the beach."

Efforts have been made, on a limited scale (particularly in the Cleveland park system), to incorporate "cultural gardens" (Shakespeare gardens, etc.) in botanical gardens and arboretums. Though it cannot be too difficult, amazingly few botanical gardens have attempted the reconstruction of a Colonial garden (there exist several excellent outlines and planting lists). On pp. 459 and 460 we have reproduced the plans of two colonial gardens in the hope that they may be a stimulus.

The brief, general bibliography at the end of this issue, prepared at Dr. Wyman's request, by our Mr. W. Baron, from entries in the Arnold Arboretum and Chronica Botanica library, may also be useful; it contains no references to purely historical literature, no accounts of specific gardens (though it is well to remember that some of the accounts of the large gardens, as Dahlem, Paris, La Mortola, Kew, Leiden, São Paulo, etc., contain much of a general nature!), nor material on collecting, transporting, acclimatization, and labeling of plants. There are only a few references to such special *horti* as alpine gardens, drug plant gardens and school gardens, which does not mean that these gardens do not belong to the field with which we are concerned! Going through these books and papers, we find that there are many opinions about what constitutes a botanical garden and what an arboretum, that no *communis opinio* exists. Personally I tend to follow Petzold's definition: "Ein Arboretum ist eine geordnete Zusammenstellung aller Gehölze, das heisst in dem hier genommenen Sinne, aller derjenigen holzartigen Pflanzen, für die bei uns die Möglichkeit der Kultur im freien geboten ist, und die insofern das Material des Landschaftsgärtners bilden." (Arbor. Muscaviense, 1864).

INTRODUCTION

At its annual convention in St. Louis, November 1946, the American Association of Botanical Gardens and Arboretums decided to assemble an up-to-date list or directory of the botanical gardens and arboretums which are now active in North America. This action was proposed by Mr. ROBERT PYLE who was editor of a former directory published by the American Association of Nurserymen in 1939. One other work of this kind was prepared by Dr. C. STUART GAGER of the Brooklyn Botanic Garden in 1938. The Arnold Arboretum assembled its own list in 1937 but never published it. To date there has been no general treatise published on the broad subject of America's Botanical Gardens and Arboretums. Such a book which may be expected to appear shortly, has been written by GORDON D. COOPER of Cleveland, Ohio. Mr. COOPER has been a member of the prominent landscape firm of A. D. TAYLOR Offices for many years and is also closely associated with the Holden Arboretum. The American Association of Botanical Gardens and Arboretums will welcome the appearance of such a book and is, in fact, completing this directory in time so that it may be used in whole or part as preliminary and supplementary material for Mr. COOPER's booklet.

The present task has been no easy one. Much has happened to this country and its people since these earlier publications, and changes have been made. During the war, many of the gardens previously listed as active found the times so difficult for continued operation that this survey has disclosed a number of them have closed permanently. Since the end of World War II, movements have started in various parts of the country for the formation of new arboretums and botanical gardens. Where these places are known, they have been listed. Those that have been permanently closed have also been listed. There are still others which have failed to respond to three letters asking for information for this directory. These have not been listed, particularly since no information has been available from well informed individuals living close to them.

It is very difficult to draw a clear line between a garden, a park and an arboretum or botanical garden. Yet it is essential to do this for the purposes of this directory. A garden is usually for the personal enjoyment and recreation of the owners and their friends. A park is primarily established for recreational purposes of the public. An arboretum or botanical garden on the other hand may be used for public enjoyment and recreation but most of all for the education of the public. The plants are properly labeled or recorded and usually they include in their functions a certain amount of research concerning the plants themselves, their culture and use.

Obviously, there are times when the segregation of one group from the other is most difficult. The classification in this directory is based chiefly on information supplied in response to over 200 questionnaires sent to all parts of North America, partly on personal knowledge and partly on published information about them. These lists have also been checked over by the present officers of the American Association of Botanical Gardens and Arboretums, whose experience was called upon to make certain that mistakes and omissions in these lists will be held to a minimum.

The arboretums and botanical gardens discussed in this directory are scattered over a tremendous range of climatic conditions. The hardiness map (*cf.* p. 466/467) superimposed on the map of the United States and Canada shows, in a general way, the minimum temperature variations in these arboretums and botanical gardens of this continent, but minimum temperature is only one of the factors affecting hardiness. There are some gardens where only 90 days of growing weather between frosts can be expected. Rainfall ranges from less than ten inches a year to over sixty inches, with minimum temperatures from 30° F. to —40° F. and maximum temperatures up to 115°F. It is evident from this, that these display gardens of North America can grow a wide range of plant material.

This is not an historical essay on the subject, but rather a documentary effort to show what the present arboretums and botanical gardens of this country are like, where they are located, methods by which some of them are established and as far as it was possible to find out the type of work some of them are doing. At the same time it was thought advisable to give some information, in a general way, on how to establish an arboretum or botanical garden. Many organizations and individuals are continually writing for such information — information which is frequently difficult to give in a letter. The article included in the directory on "How to Establish an Arboretum" is one I wrote two years ago and have modified slightly for inclusion here. It does not answer all the questions, but it does point out some of the most troublesome problems. With these in mind, and with the data on the active arboretums and botanical gardens available in this directory, it is hoped that this combined information may help to advance the interests of all botanical gardens and arboretums in North America.

THE AMERICAN ASSOCIATION OF BOTANIC GARDENS AND ARBORETUMS

Information desired for official directory of all arboretums and botanic gardens in the United States and Canada

Name of Arboretum or Botanic Garden Missouri Botanical Garden and Arboretum

Address St. Louis, Missouri

Founded by Henry Shaw about 1860
Established under Board of Trustees 1890 Acreage 75 acres in St. Louis
1600 acres at Gray Summit, Missouri

State the chief functions of your institution Scientific and recreational

Are the majority of the plants labeled or properly recorded Yes

Specializing in succulents Yes perennials Some annuals For floral display

evergreens Yes woody trees and shrubs Yes, to limited extent

Any particular genera Tropical Water-lilies and orchids

Number of species and varieties 12,000

Public ownership by

Private ownership by Self-perpetuating Board of Trustees originally named in Henry Shaw's will (A charitable trust)

Endowment $5,000,000 Operating budget $150,000 to $200,000

Admission free to public Yes Open to public at all times Yes, 8:30 a.m. to 5:00 p.m.
Sundays 10:00 a.m. to 5:00 p.m.

If not, when Except Christmas Day and New Year's Day

Display greenhouses Yes Service greenhouses Yes

Present Director Dr. George T. Moore No. of employees 75
(City Garden and Arboretum)

Do you engage in plant breeding Yes

Do you have a library Yes No. of vols. 57,317 ; a garden herbarium of material grown Yes
Pamphlets 98,147

Do you have a refreshment stand or lunch room on the grounds No.

Do you conduct any special events for the benefit of the public Floral displays under glass - Chrysanthemum, Orchid, Spring Flower Shows, Course for amateurs in Horticulture, also plant breeding, Lectures to Garden Clubs, and so forth

Do you publish a guide or descriptive pamphlet Yes Date of last edition March, 1947

Do you have any serial publications Yes What are they BULLETIN, published monthly
ANNALS (Scientific) published quarterly

References to any articles fully describing your arboretum and its activities

Chemurgic Digest, May, 1945, Vol. 4, No. 5, Pp. 97-100
House Beautiful, March, 1947, Vol. 89, No. 3.
Parks and Recreation, Vol. 29, Pp. 297-302.

Numerous magazine and newspaper articles over the past twenty-five years.

Signed Jean Whitaker [signature], Secretary

Address 2315 Tower Grove Avenue, St. Louis (10) Missouri

Please return this to Dr. Donald Wyman, Arnold Arboretum, Jamaica Plain 30, Massachusetts

— The Questionnaire issued in the Spring of 1947 —

GENERAL DISCUSSION OF THE QUESTIONNAIRE

A reproduction of a questionnaire appears on page 403. This was sent to every arboretum or botanic garden listed in the reports of Mr. ROBERT PYLE (1939) and of Dr. STUART GAGER (1938) together with many others. Not all questions were answered but the intent of certain questions is worth mentioning. The number of species and varieties, acreage, endowment and employees all tend to show the extent of the institution. The question about plant breeding has brought out the fact that a surprising number are now engaged in it. The questions on publications, library and herbarium all tend to add information which proves most helpful in estimating the caliber of an institution. The question on "lunch room on the grounds" brought out the fact that only about a half dozen provide such facilities.

Many of the institutions and gardens have published guides about their plantings and these are most helpful to the out of town visitor. Articles have been published by many describing their work and accomplishments in detail, and these too are listed and should prove helpful.

One question which might be asked is how is it possible for a garden with only 183 different species to be selected for the list? On the half acre lot about my former home I grew well over 250 woody plants and perennials, and certainly there are many larger places throughout the country with many more. The answer should be that places listed in this directory with such a small number of species and varieties are included because the garden is situated in such a cold area that only a few types grow there, or else in such gardens they specialize in growing one particular group of plants.

Mention should be made of the large number of municipal, state and national parks throughout the land, as well as countless hundreds of small "nature trails" where interested people and organizations have taken the pains to label information about plants and their identification. It is impossible to enumerate these in the present directory. There are no national parks or parts of them in the United States at least which can qualify as active arboretums or botanical gardens under the stipulations already mentioned. It is also important to note, that all those places listed in this directory have their plants clearly labeled or recorded for public inspection.

The American Association of Botanical Gardens and Arboretums expresses its thanks to the American Association of Nurserymen for the use of the directory which it published in 1939 as valuable groundwork for the present revision and expansion, and is especially appreciative of financial assistance afforded by the American Association of Nurserymen towards the publishing of this manuscript.

HOW TO ESTABLISH AN ARBORETUM OR BOTANICAL GARDEN

Numerous requests are received from time to time by the principal arboretums and botanical gardens of the country for information as to how to start an arboretum. Such inquiries clearly indicate that the arboretum idea is definitely being considered in widely separated parts of the country.

Professor CHARLES SPRAGUE SARGENT, first director of the Arnold Arboretum, long ago realized the need for arboretums or maintained plant collections strategically located in the various climatic zones of North America. Many new arboretums were established during his lifetime. Such institutions are not competitive but cooperative, and today there is a great need for more of them.

Botanical gardens on the other hand, are much older in this country and abroad. Some which were established early in the eighteenth century and have since been abandoned are not recorded in this directory of present day arboretums and botanical gardens. It is obvious that there is an ever growing desire on the part of the public to have named collections of plants, both native and exotic, for observation as well as for study and enjoyment in places where they can best be seen and appreciated.

An arboretum should be carefully planned, well financed, and competently administered. This article is devoted to some of the ways and means of establishing and maintaining a satisfactory arboretum or botanical garden, many of the suggestions here offered resulting from observing the successful development of various institutions in widely separated parts of the country.

Definition:— An arboretum or botanical garden, as considered in the following discussion, is an ample area set aside for the growing and effective display of all the different kinds of worthy ornamental trees, shrubs, vines and other plants which can be grown in a given area, their maintenance, proper labeling, and study. It does not necessarily have to include all the plants that can be grown in a region, nor does it necessarily have to include formal beds or borders of annuals and perennials.

An arboretum differs from a botanical garden in that the emphasis is placed on the growing of woody plants in the arboretum, whereas in the botanical garden emphasis is not placed on the growing of any particular kind of plant, but all types are grown. Large rock gardens and expensively operated rose gardens are frequently found in an arboretum or botanical garden but these are not essential parts of either.

Both differ from a park in that in the former a serious effort has been made to plant an extensive collection of many kinds of labeled plants not only for the purpose of display but also for critical examination and scien-

tific study. Many parks are planted without the labeling of any plants and with the use of only a small number of locally available plant species. Some parks, it is true, contain a certain number of labeled plants, as for example the Boston Public Garden; Roger Williams Park in Providence, Rhode Island; Fairmont Park in Philadelphia; and others throughout the country, but no consistent effort is made in most of them to label and keep labeled all the different kinds of plants grown. Both a park and an arboretum or botanical garden can be used for recreational purposes; but the arboretum or botanical garden go beyond the park in that they become highly educational to many of their visitors, demonstrating by means of labeled specimens what good species are available for planting in a given area or can be grown indoors.

The purpose of any arboretum, be it large or small, is primarily to grow (and to keep labeled) the best of the ornamental woody plants which will thrive in a given locality. Many other objectives may be considered, such as the actual introduction of new plants into cultivation, actual exploration of remote regions, the growing of all types of woody plants hardy in the area, scientific investigations of various kinds including plant breeding and hybridization, the maintenance of a large herbarium and library, and laboratories of various types—these may be legitimate functions of an arboretum, depending on the funds available, and the qualifications of the members of its staff.

Botanical gardens may have even wider functions for their aims are wider, including as they do representatives of the whole plant kingdom from the tropics to the Arctic, grown outside or under glass. However, small communities should not be deterred by these weighty and often expensive objectives for they may be omitted altogether where funds for the maintenance of such purposes are unavailable. If an arboretum effectively demonstrates "the best" of the woody plants hardy in its area, this alone will make it a most valuable asset in the community it serves. The botanical garden need not cover a large area. It can be effective on a few acres with a few display greenhouses and display a representative collection of plants from all over the world.

Charles Sprague Sargent, first director of the Arnold Arboretum, used to say that in order to start an arboretum it was necessary to have a thousand acres of land with at least a million dollars endowment; yet he started an arboretum with only 125 acres of land and one hundred thousand dollars endowment, and in the early years of the Arnold Arboretum he had only one third of the income of that modest endowment for annual expenditure. There is still the need for large arboretums placed in different regions representing different climatic conditions where all the woody plants hardy in an area may be grown and which are well endowed for scientific investigations. This is undoubtedly what Professor Sargent had in mind, for the Arnold Arboretum was, and is, that kind of an institution. But times are changing. With the extensive garden club movement and increased tendency away from urban dwelling, more and more people are becoming interested in the growing of plants. The Victory Garden movement has undoubtedly aided this development during the past war.

A new conception of an arboretum is coming into being. This is very well expressed in the plantings of the Arthur Hoyt Scott Horticultural

Foundation at Swarthmore College, Swarthmore, Pennsylvania. It is adaptable to communities smaller than Boston, Philadelphia, Chicago, New York, St. Louis or Seattle. It is feasible where funds are lacking to finance expensive scientific investigations, but where there is a definite need to grow and demonstrate to the public "the best" plants hardy in a particular area. It is readily seen that this idea is a flexible one for the actual size of the arboretum or botanical garden may vary considerably. The idea is based on the theory that the same old varieties of plants may be superseded by new and better varieties. There are new varieties of cars, of refrigerating devices, of clothes and women's hats, and there are new varieties of plants as well. In the display gardens the "old" varieties are grown side by side with the "new", both often being available to the plant-buying public. But with the best varieties only being displayed, interest and variety in private and municipal planting will be greatly stimulated. With this conception in mind, the committee responsible for planning an arboretum or botanical garden should be so constituted as to give the best advice possible for its usefulness and adaptation to the community.

Functions of an Arboretum or Botanical Garden:— The purposes of establishing a display garden should be carefully considered before the plan is publicly broached. Some of the more important functions of such a garden might be:

1) To grow "the best" plants hardy in the area in order that home owners may become acquainted with their names, their ornamental characteristics and the proper methods of culture.

2) To show a complete selection of all that is considered the best from an ornamental standpoint among the woody plants (if an arboretum or among the perennials, annuals, bulbs as well if a botanical garden) that it is possible to be grown in the area.

3) To serve as a means of introducing new plants into the area, regardless of the source from which they may come.

4) To disseminate knowledge of plants to the public. This would include information on culture, pruning, fertilizing and possibly a continual study under local conditions of just what varieties are "the best" including cooperation with schools, garden clubs and other organizations.

5) To test the hardiness of untried varieties.

6) To provide a laboratory for students of botany, horticulture and nature study.

7) To increase the productivity, economic importance and beauty of an area, by intelligent and interesting planting, and by introducing plants not grown there before.

8) To provide recreational stimulus to the public by means of walks, drives and beautiful displays, flower shows, etc., and to stimulate the pleasure of learning to know new plants which might be adapted to planting on private property.

Each one of these functions should be studied individually with view to the best interests of the community. One of the first decisions to be made is whether the present park system satisfies the needs and desires of the people or whether its scope should be enlarged. Would the people be interested in a garden of woody plants only, or should an expensive display greenhouse for showing material in the winter be included? It is important to consider that an arboretum will always be less expensive to operate even if it includes a large variety of woody plants. On the other hand there are some communities where plant displays in large conservatories fill a real need in the winter. If this is the local situation and funds are available the construction of display greenhouses filled with exotics must be considered.

If the community is small, the effective functions of the display garden

will be largely display. If the community is large and funds are available, the functions may also include scientific investigations, especially if there is an institution of higher learning with which the arboretum may be connected. How far this may be extended will depend upon the community, its nearness to other large institutions, the availability of funds, and on leaders in the municipality..

Method of Establishing an Arboretum or Botanical Garden:— The first arboretums and botanical gardens started as *private gardens* when individuals became interested in assembling a collection of plants. JOHN BARTRAM has the credit of establishing the first large collection of trees and shrubs in this country when he established his garden in 1728 at Kingsessing on the banks of the Schuylkill River near Philadelphia. Since that time, many private collections have been established at one time or another but many of them have passed out of existence after the death of the original owner. Today there are a few private arboretums worthy of the name. Among them would be the one started by Mr. H. H. HUNNEWELL in Wellesley, Massachusetts, in 1852, and devoted mainly to conifers; and that of Mr. STANLEY ROWE of Cincinnati, Ohio, which now contains 2500 different kinds of woody plants.

A local community can have an arboretum as a result of cooperative effort by various local organizations. An example is the Trumbull Arboretum of Warren, Ohio. Funds are raised by local committees of enthusiasts to produce and maintain the type of arboretum wanted by a majority of the community — in this case one showing the local flora fully supported by the community and not the state.

The government operated arboretum is exemplified by the Dominion Arboretum adjacent to the Experimental Farm in Ottawa, Canada. This is 61 years old and contains about 2000 species and varieties of woody plants. It is owned and operated by the Canadian government. Our own National Arboretum at Washington, D. C., has been started, but progress in development has been delayed by lack of available funds. Even national government budgets are frequently the playthings of legislators, and the future of an arboretum under government jurisdiction, though safer than a private arboretum, may still suffer much from a fluctuating annual budget.

An arboretum is sometimes part of the *park department* of the city. Such is the case with Highland Park and Durand-Eastman Park in Rochester, New York. The 484 acres constituting Durand-Eastman Park were originally a gift to the city, made by Dr. HENRY S. DURAND and GEORGE EASTMAN, but maintenance operations are carried out exclusively by the city Park Department, support being from city taxes. The advantages are obvious, for the park personnel is usually well equipped to maintain a collection of trees and shrubs. However, disadvantages are often evident. In many a park department the annual budget is subject to devious manipulations by politicians who may have no interest in park plantings and in all too many cities in this country the park department budget is the first to suffer reductions when city expenditures are cut.

The best method of establishing an arboretum or botanical garden is to provide a properly safeguarded *restricted endowment,* the income from which may be used only for specified purposes. The endowment should

be sufficiently large to provide a reasonably ample annual income, for only in this way can permanence be assured. It will be necessary for the Planning Committee to estimate the annual expenses in advance. Many arboretums today are being operated wholly or in part by income from endowments. The endowment is not sufficient in some instances to cover all expenses and additional funds are necessary from the tax budget or from private sources in order to make it possible to attain the ends desired. When the income from an endowment must be augmented by annual popular subscriptions or by annual grants from the city park department, many difficulties arise. This is, in general, a most unsatisfactory way of operating an arboretum, for projects started one year when funds may be ample may have to be curtailed or even discontinued in another year. Success is most assured when an endowment is possible.

Usually a board of directors is formed to oversee the administration of funds in privately endowed institutions. Such is the case with the Morton Arboretum at Lisle, near Chicago. Frequently it has been found advisable to associate the arboretum (with its endowment) with an institution of higher learning. Such is the case with the Arnold Arboretum (Harvard University), Arthur Hoyt Scott Foundation (Swarthmore College), Morris Arboretum (University of Pennsylvania), each one of which has its own endowment. The Arboretum of the University of Washington (Seattle) is connected with the University with most of its maintenance funds coming from state appropriations. This source is supplemented by membership fees, and an attempt is now being made to secure a restricted endowment.

The association with a university is ideal for it tends to add permanence to the arboretum; sound and intelligent advice on arboretum problems are always available from university staff members, and the arboretum can serve as an ideal out of doors laboratory to augment classroom instruction. It is also true that the facilities offered by an arboretum would be used more as a result of this association than might otherwise be the case.

When budgetary items are reasonably fixed from year to year, the work of an arboretum can proceed unhindered by extraneous circumstances. The main object in establishing an arboretum is to make it permanent, to provide for a permanently dependable source of income, and thus insure its usefulness to be continuously available to the greatest number of people. There is no better way to insure this than to provide an ample endowment at the beginning.

Selection of the Site:— Before the plan can be made, a site must be decided upon, and the size of the area to be developed should be determined in relation to the sources and amount of available funds. The site could well be a local spot of beauty, of historical significance, or an existing part of a park if suitable. It will take intelligent discussion and sound advice to decide on the site, for the general plan and the functions of the arboretum also must be considered simultaneously. Arrangements should be made for alternatives in case the amount of money originally hoped for is not eventually forthcoming. A very important factor is accessibility.

Who is to Plan:— Almost any enthusiastic temporary group may be responsible for initiating public interest in the new arboretum, but a planning committee responsible for preparing definite plans associated with a campaign for raising funds should be carefully selected. The planning committee could well include an experienced landscape architect; a representative from the park department who would know about future park plans; a banker; a person well versed in the values of real estate; prominent nurserymen; and representatives from prominent civic organizations who would represent the desire of the people to have an arboretum and the will to work for one. A representative from an active arboretum, similar in size to the one contemplated, might well be called in for consultation. Large committees move more slowly than small ones, but somehow all interests should either be represented or heard prior to the time the actual site is decided upon and the plan is completed.

Ways of Initiating Interest and Action:— It is a simple matter to propose the idea of an arboretum in any community lacking one. Except in strictly urban areas, most home owners are interested in planting their properties so as to make them beautiful and enjoyable for as much of the year as possible. In strictly urban areas the people always desire to get into the open for rest and relaxation. Consequently, people in general are receptive to the idea and do not begin to "hedge" until the time comes for asking for increased taxes or donations for endowment or for annual support.

Many community organizations are well equipped to assist in a campaign for an arboretum. The garden club movement is fortunately firmly imbedded in almost every community. Nature clubs, bird clubs, forestry associations, conservationist groups and other organizations by their very nature should be interestetd in the idea and their members afford an excellent basis for enthusiastic support. Schools, parent-teachers organizations, Rotary and Kiwanis Clubs, women's organizations, church groups, town park departments, all should be thoroughly canvassed and their support enlisted.

Horticultural experts could give illustrated lectures to show the kinds of plants which might be grown. Local landscape architects could have a field day in discussing possibilities. Staff members from existing arboretums could come and show what has been done in other communities, and discuss frankly the possibilities of a local arboretum. Costs could be discussed by committees representing various organizations. When opinion becomes fairly crystallized, some group could offer a sum to be used for the preparation of a definite plan. This was done in Seattle with excellent results. It was felt by those in charge that a topographic map of the Seattle Arboretum site was necessary, showing the two-foot contour lines. Such a map was prepared by the State W.E.R.A. at a cost of $5,465.00. Then the Garden Club of Seattle raised $3,000.00 and under its auspices a plan was drawn by a prominent firm of landscape architects. By the time the plan drawing stage is reached, public opinion should be fairly well crystallized in the form of a planning committee or "Arboretum Committee" which would have the authority to work with the individuals drawing the plan.

It is always advisable to have a well conceived plan on paper, regardless of what the local situation may be. The man or men eventually to be in charge of an arboretum do not just begin to plant trees and shrubs. Roads must be constructed, paths provided for pedestrians, a certain amount of grading done, certain plants placed in situations where they will grow best, a propagating unit intelligently placed, water pipes laid where they will do the most good, drainage provided for in certain instances — in short, a thousand and one things should be thought of before the actual planting is started. In some instances the soil of the arboretum site may be very poor, and arrangements must be made to grow cover crops on it for several years (this was done on the site of the National Arboretum in Washington), thus preparing the soil over a period of time before any trees or shrubs are planted. Water, in the form of a running brook or a pond, can be used to excellent advantage if properly planned for, whereas without planning such a feature might easily become a liability. Trained horticulturists experienced in arboretum objectives and various professional landscape architects are familiar with these phases of the project. Thus if carefully considered plans are prepared in advance, much money can be saved, and many disappointments avoided by doing the right thing at the right time in the right manner.

How to Plant:— The actual placing of the different groups of trees and shrubs should be done according to a carefully conceived plan in which the individual needs of the plants are harmonized with the requirement of good landscape design and in which the best interests of the public are also considered.

Some of the arboretums have been laid out so that the plantings follow a definite botanical sequence of families and genera. This is not necessary or essential in most arboretums. It is advisable to keep all the plants in a certain genus together if possible, and to so place the important genera that they are easily seen from roads and paths. All projected plantings should be critically considered from the standpoint of landscape design.

Azaleas and rhododendrons, if used, should be given a situation with acid soil where they have some protection from winter winds. Lilacs should be so placed that people can easily walk among them and observe them closely as well as from a distance. A collection of hickory or walnut trees, for instance, might be placed in an out-of-the-way spot, where they can be seen from a distance. Colorful displays that have particular seasonal interest should be easily accessible and where they can be seen from many vantage points. Some plants like wet soils, some do better in dry soils. Each group should be placed where it will grow best.

Special attention should be given to displays of seasonal interest. Lilacs, for instance, are of interest only in the spring and might well be grown near the viburnum collection, which is of interest chiefly in the fall. The oriental crab apples, on the other hand, have seasonal interest both spring and fall and hence might be in a spot by themselves. Certain azaleas and the flowering dogwood bloom at the same time and might be planted adjacent to one another. A bank of red roses that will bloom in late June might be planted near the collection of mock oranges to give it additional color interest when its white flowers appear. Evergreen trees are fre-

quently kept by themselves, but intelligent planting would call for the placing of a few deciduous trees in such a collection, especially those which color vividly in the fall, to lend color and variety. And in or near plantings of deciduous trees it is usually desirable to place a certain number of selected evergreens.

It may be advisable from a maintenance standpoint to grow many shrub groups together in long beds with grass walks between them. Planted in this manner the shrubs are easily observed closely. A large number can be studied with comparatively little effort, and direct comparisons made. Roses, and representatives of such genera as *Weigela, Spiraea, Deutzia, Philadelphus, Chaenomeles,* and several other genera come in this group that can be so treated. Such a collection, though of little landscape interest, has a great deal of interest to the public at all times of year. The "shrub collection" at the Arnold Arboretum contains a thousand different kinds of shrubs in parallel beds. It might well be one of the features in any arboretum, placed easily accessible to the main entrance, where people with little time can spend it to best advantage.

What to Plant:— What constitutes "the best" and who is competent to judge which are "the best" is always a debatable question. There are in existence several large collections of woody plants in this country and attempts are continually being made to make reliable lists of "the best" ornamentals in each group (genus or species). Such available lists could be utilized at the start. Let me explain more fully how this might be done, using the collections at the Arnold Arboretum as an example.

At the present time there are approximately 6000 different species and horticultural varieties of woody plants being grown in the Arnold Arboretum. Certain groups are larger than others. Thus in these collections there are 72 viburnums, 98 mock oranges, 132 maples, 180 crab apples, 450 lilacs and 550 hawthorns. Taking the lilacs for closer scrutiny, there are approximately 330 varieties of *Syringa vulgaris* alone, of which 32 have white flowers! Certainly all do not have outstanding ornamental value. In fact, it is extremely difficult to tell some of the varieties from others. It would be difficult to locate nursery sources for all, and certainly many have been discarded by commercial growers as being unsatisfactory. This large collection of lilacs has its place as a laboratory for scientific study (Mrs. SUSAN D. MCKELVEY did much of the work for her monograph on lilacs in this collection) but many of the varieties could be eliminated if scientific study were not one of the functions of this arboretum. The collections would be much more ornamental if the number of varieties were reduced, for then massed plantings of a single lilac variety could be made in space now occupied by twenty different varieties, for the ornamental effect of a massed planting is always more effective, especially for the casual observer.

In a small arboretum, a collection of 50 or even 25 varieties of lilacs might be satisfactory — only those being selected for planting which are considered to be the most ornamental and representative of the entire group. Just as many plants could be used as in our large collection if space were available, but far fewer varieties. The same principle could be used in selecting "the best" in the other groups of plants. The advice of

local plantsmen will prove invaluable at the start when considering such points.

The Number of Plants:— The number of plants selected at the beginning will vary with the part of the country in which the arboretum is located, with its size, financial resources, and its propagating facilities. A few examples will illustrate this point. In making a preliminary report of proposed plantings for the Cornell University Arboretum, now called "Cornell Plantations," there were approximately 2,000 species and varieties of woody plants listed as worthy of trial at the beginning. The Arthur Hoyt Scott Foundation of Swarthmore College listed approximately 2,800 species and varieties of woody plants that were being grown there in 1942. The 6,000 species and varieties now growing in the Arnold Arboretum might be reduced as much as one half or even more if only the most ornamental were to be selected. These figures are, of course, very general but they give some idea of the number of plants worthy for first consideration. The American Association of Botanical Gardens and Arboretums has published two inclusive studies, one on lilacs, the other on crab apples, showing the tremendous number of varieties being grown in this country and offering suggestions for short lists of the best. Such lists should be consulted. The smaller the arboretum, the fewer the number of specimens of any one variety which should be grown.

The first places to investigate as possible sources for plant materials would be the local nurseries. Nurseries at a distance may be able to supply many varieties unavailable locally. It will, of course, be found that some species are unobtainable from commercial sources. Then it is necessary to provide for a propagating unit and grow wanted varieties from seed, cuttings or by grafting, where the propagating material is supplied by other arboretums, private individuals, or in some instances where seed is collected in native habitats primarily for this purpose. The smaller the plants when purchased, the lower the initial expenditure. The larger the plants at the start, the more quickly an initial display can be made for the public to enjoy. The factors here involved are obviously important ones and should be carefully weighed by the local planning committee.

The Amount of Space Required:— This, too, varies with the arboretum, its size, funds available for maintenance, and its functions in the community. Should much space be given over to massed plantings of single varieties? Massed plantings of azaleas, lilacs and crab apples are most ornamental and can be extremely effective, whereas massed plantings of maple trees, for instance, take up much more space and have little ornamental effect. The enforcing of a rigid rule that no more than two or three plants of any one variety can be planted might be enough to defeat the purposes of an arboretum in the eyes of the public. The Arnold Arboretum proper covers an area of 265 acres, yet there is little room for additional planting, even though nearly half the present area is woodland. This wooded area is considered absolutely essential in setting off the man-made plantings to good advantage, and to serve as an added source of beauty and interest to visitors. Viburnums alone take 30,000 square feet (190 plants), while mock oranges take approximately 34,200 square

feet (184 plants). Three and a half acres constitute what is known as the shrub collection — long beds of miscellaneous shrubs with grass walks between, in which about 1,000 different species and varieties are grown. Almost a third of this is taken by the grass walks. Such a shrub collection affords an excellent means of teaching the public a great deal in a small area, but affords no opportunity for gorgeous displays of massed plant materials.

Another way of approaching a decision on the amount of space necessary would be to take the figure of 2,000 species and varieties as a starting point (the number suggested as the starting point for consideration by Cornell Plantations). If two plants of each of these were planted in long nursery rows, the distance between plants averaging 20 feet, they would take about 37 acres. Would such a planting in nursery rows have aesthetic value and be of interest to the public? Of course not! On the other hand, the proverbial "thousand acres" might prove too much for practical purposes. Here is another opportunity for intelligent planning by the Arboretum Committee, and an opportunity where practical plantsmen and landscape architects can lend invaluable assistance.

Costs:— The maintenance of plants in an arboretum need not be expensive. Spraying, pruning, planting, should not be curtailed in any one year. If spraying and pruning be omitted two or more successive years because of lack of funds, the plantings quickly show neglect and it may take several years to bring some of the plants back into vigorous growth. A fluctuating budget does not allow for intelligent annual operation, one of the best arguments against trying to operate too extensively on the basis of funds solicited annually.

The actual amount of money necessary to operate a small arboretum varies with the size of the arboretum, the labor situation, equipment, the objectives and the extent of its formal plantings. A good park administrator who knows park maintenance costs in the locality where an arboretum is to be established can give excellent advice regarding such costs. However, certain things are known. Lilacs, crab apples, quinces, and many other groups are very susceptible to infestations of scale and should be treated annually with a dormant spray to control this pest. They need a certain amount of renewal pruning every few years, without which periodic care they will very quickly turn into unattractive specimens which have little ornamental value. No collections of these particular kinds of plants should be contemplated unless they can be cared for properly each year.

As an example of the cost for maintaining one group of plants, there are approximately 600 lilac plants in the collection at the Arnold Arboretum. Spraying these with a dormant oil spray takes four men about a half day, and about 600 gallons of spray mixture. Annual pruning is currently not carried out as well as it might be because of the present labor situation, but if three good pruners could spend an average of two weeks in this collection each year, it could be kept in excellent condition. The cutting off of flower clusters is a time-consuming operation but should be done for the benefit of the next season's display. Although we cannot do this completely every year, if done properly (as it should be) it would

take four men at least two weeks. This will give some idea of how to approach the problem of prospective costs in each of the large collections contemplated.

Viburnums need practically no spraying and very little annual pruning. Elms must be sprayed in this area for elm leaf beetle. The larch case bearer is a difficult pest to control and larch trees must be sprayed with lead arsenate as soon as small worms appear. Canker worm, gypsy moth, willow leaf beetle, Japanese beetle — all attack many kinds of plants and must be controlled in various parts of the country. Our total time spent in spraying in the Arnold Arboretum amounted last year to about thirty man-days, with approximately $250.00 expended for the purchase of spray materials. Of course, the necessary spray equipment must be available, and its initial cost must be considered.

Pruning, also, cannot be definitely estimated. Young plants, pruned properly at transplanting time, may require no pruning for several years. On the other hand, in an established arboretum with many kinds of mature trees, a wind, snow or ice storm may cause immense damage. The hurricane of 1938 cost the Arnold Arboretum in pruning and the removal of fallen or badly damaged trees and shrubs about $6,500 above the budget provided. This did not include the irreparable loss of old established specimens. During a recent winter, one fourteen-inch snowstorm with very heavy snow broke so many branches that it took approximately seventy-five man-days to repair this damage alone. There have been winters, on the other hand, when little damage was done, and pruning in the entire arboretum did not take more than a hundred man-days.

Planting:— Much time will be needed at the start of any arboretum for this operation. The size of the arboretum governs the annual planting, of course. During the past few years in the Arnold Arboretum, we have not spent more than fifty to seventy man-days in planting new specimens in the collections in any one year.

Labor:— This item is the most expensive in any park or arboretum. It can be controlled somewhat by the amount of grass cutting and leaf raking which is done. In some parks all grass areas are carefully cut with a lawn mower once a week. This is a very expensive operation. In the arboretum or botanical garden certain areas given over to the growth of deciduous trees and conifers the grass need only be cut but once a season, providing a few walks are open through these collections. In the shrub collection, which many people visit at all seasons of the year, the walks should be closely cut, as well as certain small areas along the main walks and near main entrance gates. But in many areas in the arboretum the grass need be cut only once a year and still the public will have ample space for circulation. Grass cutting is an essential annual operation to reduce the fire menace and must be provided for.

Hoeing by hand takes considerable time. The cost of this operation can be reduced by the use of mechanical equipment in the larger beds, and may be reduced still further by the use of some of the new hormone weed killers now available. The Arnold Arboretum employs eight laborers with occasional additions during spring and summer, a superintendent with his

assistant, for the maintenance of the growing collections, as well as a propagator and a man in charge of labeling and mapping. These are not maximum requirements, probably might be termed the minimum labor requirements for an arboretum the size and age of the Arnold Arboretum. The Arthur Hoyt Scott Foundation at Swarthmore with an area of about fifty acres employs seven men, a part-time director, and a part-time gardener. The Morton Arboretum with 800 acres employs approximately fifteen men for the maintenance of the grounds.

Equipment:— The more standardized mechanical equipment that can be utilized to good advantage, the less will be the expenditures for labor. Minimum equipment for a 200-300 acre arboretum might be:

Tractor (with sickle bar, plow, harrow, etc.),
Sprayer with tank capacity of at least 300 gallons,
At least one ton and a half truck,
2 power lawn mowers,
3 hand mowers,
2 sickle bar machines,
Rototiller or small motorized cultivator,
Mechanical saw.
The best available hand saws, pruners, pole saws, etc., for the type of work contemplated.

Propagation:— Every arboretum large or small should have its own propagating unit. Since many of the plants grown will be rare, they will not be available from commercial sources as plants, hence the arboretum will have to propagate many species from seeds, cuttings or grafts. There are decided advantages in having a nursery well stocked with materials, for plants so grown are easier to dig and move. They should be correctly named for if they are allowed to grow to sufficient size in the nursery, they can be properly identified before being transplanted. Larger specimens can be handled this way than would be advisable with purchased specimens.

The actual size of the greenhouse will depend on the location of the arboretum, its size, and the amount of material to be propagated. At the beginning a great deal of propagating will be needed to provide material for contemplated plantings. Many of the older arboretums are concerned merely with a few replacements and material which is new to the collections.

It is amazing what a large amount of material can be propagated and grown to planting size in a small, well organized space. The Arnold Arboretum has one propagating house 50′ × 18′ (erected with the accompanying potting shed and heating unit at an approximate cost of $20,000 about twenty-two years ago) and this is ample for its needs. The Morris Arboretum in Philadelphia has twice as much, the Morton Arboretum nearly three times as much, and the younger University of Washington Arboretum four times as much space. The Arthur Hoyt Scott Foundation at Swarthmore has only one small house, as does the arboretum in Whitnall Park in Milwaukee.

A pit house 50′ × 9′ is essential in the North and lath shade houses are a requisite in the South. Frames are essential for wintering small plants and 1800 square feet of these might very well be contemplated. Nursery space varies with the size and age of the arboretum and the need

for plant materials. The Arnold Arboretum has one to two acres of nursery space, varying from year to year; Morton Arboretum about three acres; and the University of Washington Arboretum has about seven acres under the Skinner irrigation system.

The services of an experienced propagator are essential. Sometimes he can work alone, sometimes he may need assistance, but in order to keep accurate records and to produce good plants, he should be thoroughly trained and experienced.

Labeling and Mapping:— A most essential function of an arboretum is to keep the plants properly labeled. In order to maintain correct labeling it is essential that the plantings be accurately mapped. An active young man who is really interested in this work — and it takes a great deal of walking! — should be able to keep maps and labels up to date, providing he has some seasonal assistance. In the winter some of the labor force could paint and even print labels. In the summer, one or two high school boys might be hired to help with the mapping if this were necessary. Mapping with the alidade and tape is sufficiently accurate. We have found that maps approximately $2' \times 2\frac{1}{2}'$ on a scale of $1'' = 20'$ are practicable, but a few enlargements are necessary on a scale of $1'' = 10'$. It took nearly a year for two men properly to map the 265 acres in the Arnold Arboretum a few years ago, but once accomplished, the maps are easily kept up to date with a minimum expenditure of time.

If plants are not accurately and clearly labeled, the arboretum loses its educational function completely. Labels will disappear, often being appropriated by certain types of visitors, and others will become defaced. Thus a careful mapping of a collection makes relabeling of individual plants simple and accurate, for the critical and sometimes time-consuming matter of reidentification is eliminated. One active and intelligent young man can keep a collection mapped and properly labeled, even in the larger arboretums, providing he has occasional seasonal help. A display label should be clearly visible on every plant except in instances where a large number of a single variety are used in mass planting. On the label, as a minimum, should appear the common name, the scientific name, and the geographic origin of the species.

In the Arnold Arboretum we have a small record label made of embossed zinc tape which is attached to every plant when it is planted in the collections. This remains on the plant indefinitely, and contains the accession number of the plant, its scientific name, the origin of the plant, and the date of its accession. These cost about ten cents per label for labor and materials. A larger wooden or metal display label is attached to each plant that is large enough to carry one. These cost about twelve cents per plant for labor and materials and will remain on the plant in good condition about five years. Certainly a plant worth placing in an arboretum is worth two labels at a cost of twenty-two cents. This mapping and labeling in a large arboretum may cost as much as $2500 per year, but it is worth it.

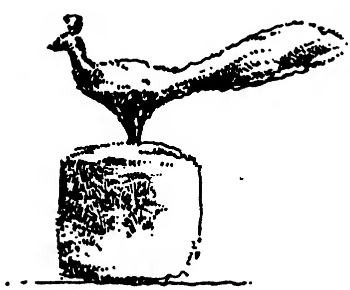
Educational Costs:— If the community is large enough, the director or superintendent of the arboretum might be a man who could direct the

work in the arboretum and at the same time give lectures to local groups concerning the plant materials in the arboretum and their proper use. He could write articles for local publication, conduct groups through the arboretum, and work with local groups for the general education of the public in better appreciation of the plants and their maintenance. The services of such a man are almost a "must" for the arboretum or botanical garden since a certain amount of educational publicity contributes materially toward a better utilization and appreciation of the arboretum by the residents of a community.

It would serve no purpose to give the actual operating expenses of any arboretum, since methods vary, functions of the arboretum vary, and wages vary. Each expense item should be understood before studying actual maintenance costs. The figures and facts given, however, should serve to help with the general plans of any Arboretum Committee. They should be interpreted by men familiar with maintenance work who at the same time are familiar with the proposed functions of the arboretum under consideration.

A perusal of this directory will show the locations of the arboretums and botanical gardens of the country, institutions which are always glad and willing to help with information or suggestions when a new garden is contemplated. The points mentioned in the above discussion are only a few of the most important, but may help to suggest ways and means of solving the many problems connected with establishing and successfully maintaining a new display garden.

The ACTIVE ARBORETUMS *and* BOTANICAL GARDENS *of* NORTH AMERICA



An alphabetical list of the Arboretums and Botanical Gardens included, with a map, will be found on *pages* 465-468, a list of all place names on *page* 482, and a list of the illustrations on *page* 398

— *ARIZONA* —

1. *Superior:* **Boyce Thompson Southwestern Arboretum**

Est. 1924 — 1700 acres*

Chief functions: Educational and scientific, plant introductions.

Situated 60 miles from Phoenix this arboretum features the flora of the whole section in which it is located. The arboretum was the former home of the late WILLIAM BOYCE THOMPSON; founder of the Boyce Thompson Institute of Yonkers, New York. He wanted to do something of benefit for the people of this region similar to what he contemplated at Yonkers. The area is actually more properly a botanical garden than an arboretum, the only income being from the endowment created by Colonel THOMPSON.

This is one garden where the lack of water very definitely limits the amount of planting especially for any other than drought resisting plants. Much of the grounds is in reality a natural rock garden and the plantings are therefore informal. Irrigation is supplied from an artificial lake of 4,000,000 gallons of pumped water but this is not much considering that the annual precipitation normally is only 10-15 inches.

Consequently this is about the only sizeable garden in the United States where drought resistant plants, *i.e.*, desert plants, are grown and featured on a large scale.

Featuring: Succulents, woody trees and shrubs.
Species and vars.: 3,000.
Ownership: Self-perpetuating corporation.
Admission free and open to the public at all times.
Director: FREDERICK GIBSON. — *Employees:* 5.
Display greenhouses: 2. — *Service greenhouses:* 3.
Library: 1,500 vols. — *Herbarium* for Arizona plants.
Special events: Lectures to special groups.
Publications: Descriptive pamphlet issued (1930). — Seed lists for exchange.
References: "Boyce Thompson Southwestern Arboretum, Purpose, History, Dedication". Forest Worker 6, No. 1, June 1930. — "A Visit to the South West Arboretum" by HELEN M. FOX, Nat. Hort. Mag. 15, No. 3: 185-187, July 1936. — "Boyce Thompson Southwestern Arboretum" by FRED GIBSON, Parks & Recreation 25, No. 7: 278-282, March 1942.

2. *Tempe:* **Desert Botanical Garden of Arizona†**
(in Papago Park near Phoenix)

Est. 1939 — 306 acres

Chief functions: Assembling of the desert flora of the world for study.
Featuring: Succulents, woody trees and shrubs—xerophytes.
Species and varieties: About 6000.
Ownership: Arizona Cactus and Native Flora Society.
Endowment: $250,000.00. — *Operating budget:* $10,000.00.
Admission free and open to public from 1 p.m. to 5 p.m. except Mondays.
Service greenhouse: 1.
Director: W. TAYLOR MARSHALL. — *Employees:* 3.
Library: 1000 vols. — *Garden herbarium.*
Special events: Lectures Sundays and Thursdays.
Publications: Descriptive pamphlet, Monthly bulletin, occasional taxonomic papers.
References: "Desert Botanical Garden" by HOMER G. RUSH, The National Horticultural Magazine, January, 1947.

— *CALIFORNIA* —

3. *Anaheim:* **Rancho Santa Ana Botanic Garden‡**

Est. 1927 — 200 acres

Chief functions: Provides facilities for research in native plant life of California.

This is situated about 45 miles from Los Angeles, and is the culmination of the efforts of Mrs. SUSANNA BIXBY BRYANT, its founder and first director, who died in

* 30 acres — cultivated plants; 670 acres — wild plant area; 1000 acres — Natural area owned by U. S. Forest Service — Land, Special Use Permit.

† Box 647.

‡ R.F.D. 3, Box 327-B, Orange County.

the fall of 1946. It was through her interests and because of funds provided by her that this garden has become so important to everyone interested in the local flora of this area in California. It is on property chosen because of its commanding view of the river valley and the Santa Ana Mountains. It is traversed with five miles of roads and twelve miles of trail so that all parts of its deep ravines are accessible. It features a great many species native to this area of California. In 1943 over one-third of its area was ravaged by fire.

Featuring: Succulents, perennials, woody trees and shrubs — *Ceanothus, Cupressus, Godetia, Gilia, Pinus, Rhamnus, Quercus, Opuntia,* etc.
Species and vars.: 1200-1500.
Ownership: Board of Trustees.
Admission free and open to public on Fridays and Saturdays in April and May, 10 a.m. to 4 p.m. Open to botanists at all times.
Director: Dr. PHILIP A. MUNZ. — Employees: 12.
Library: 3000 vols. — *Garden herbarium* of 30,000 sheets.
Special events: Wildflower shows presented and special talks given for the public.
Publications: Descriptive pamphlet. — Serial publication, "El Aliso."
References: "A Short History of the Rancho Santa Ana Botanic Garden" by PHILIP A. MUNZ, May 1947.

4. *Berkeley:* **University of California Botanical Garden**

Est. 1930 — 35 acres

Chief functions: Teaching and research.

Situated near the head of Strawberry Canyon within sight of San Francisco Bay, this botanical garden is growing vigorously under the wise direction of Dr. GOODSPEED. In addition to its function as a source of plant materials required for class instruction, the botanical garden has emphasized a series of research collections. A collection of 200 species and hybrids of Rhododendrons was given to the garden by friends and 150 more were added as a result of the garden's plant hunting in the China-Tibet border region. There are 200 species and forms of roses and a greenhouse containing over 2000 members of the *Cactaceae, Euphorbiaceae, Crassulaceae* and other families. A palmetum is under development near the herbaceous garden. One greenhouse is given over entirely to orchids from tropical America, especially from Colombia and Peru.

Featuring: Succulents, evergreens, woody trees and shrubs — *Nicotiana, Rhododendrons, Rosa, Camellia,* Cacti, Orchids of tropical America, plants of temperate South America.
Species and vars.: 8000.
Ownership: Regents, University of California.
Admission free to public and open from 9 a.m. to 4 p.m. daily.
Director: Dr. T. H. GOODSPEED. — *Employees:* 5.
Display greenhouse: 1. — *Service greenhouses:* 4.
Plant breeding!
References: "The University of California Botanical Garden" by T. H. GOODSPEED, University of Washington Arboretum Bull. 10, No. 1: 12, 13, 29, Spring 1947.

5. *Los Angeles:* **Botanical Garden, University of California**

Est. 1933 — 15 acres

Chief functions: Teaching and research.
Featuring: Succulents, perennials, evergreens, woody trees and shrubs.
Species and vars.: 800 species, 638 varieties.
Ownership: University of California.
Admission free and open to public at all times.
Asst. Dir.: Dr. F. MURRAY SCOTT. — *Employees:* 2.

6. *Placerville:* **Institute of Forest Genetics**

Est. 1925 — 106 acres

Chief functions: Breeding pines for timber production.
Featuring: Evergreens, woody trees and shrubs, pines.
Species and vars.: 71 pine species, 20 hybrids, and 38 other coniferous species used for decorative purposes.

Ownership: U. S. Gov., operated by Forest Service, U. S. Dept. Agric.
Founded by JAMES G. EDDY and operated from 1925 to 1932 as the Eddy Tree Breeding Station — deeded to U.S. Gov., in 1935.
Operating budget: Congressional appropriation.
Admission free to public Mondays through Fridays 8 a.m. to 4:30 p.m.
Director: Dr. WILLIAM PALMER STOCKWELL. — *Employees:* 10.
Service greenhouse: 1.
Plant breeding!
Special events for classes, forestry societies, etc.
Publications: Descriptive pamphlet in press. — Research results in various publications.

7. *San Francisco:* **Strybing Arboretum at Golden Gate Park**

Est. 1939 — 40 acres

Chief functions: Demonstration of ornamental plants of merit.

Established by means of a bequest in the will of Mrs. HELENE STRYBING, this arboretum is very fast becoming an important one for it is situated in a climatic zone where much material can be grown that will not survive in any area other than southern California, Florida, and possibly a portion of the Gulf states. Although considerable of the planting is fairly recent, nevertheless there is much of value already growing well. It is serving as a center of plant information in a densely populated urban area, where growing conditions are frequently most difficult with extremes in amount of precipitation and often temperature. The close proximity of the surrounding Golden Gate Park makes it all the more important and useful to those who are interested in plants.

Featuring: Native annuals, evergreens, woody trees and shrubs — *Rhododendron, Magnolia, Escallonia,* etc.
Species and vars.: 3,500.
Ownership: City and County of San Francisco.
Operating budget: $24,000.
Open to public daily from 10 a.m. to 5 p.m.
Director: ERIC WALTHER. — *Employees:* 10.
References: "San Francisco Bot. Garden, Arboretum in Golden Gate Park" by E. WALTHER, Nat. Hort. Mag. 19: 153-156, July 1940. — "America's Public Gardens. — Golden Gate Park Arboretum" by G. ROUNTREE, Gard. Chron. of Am. 50: 68, Mar. 1946. — "Strybing Arboretum at Golden Gate Park," Parks & Recreation 27, No. 1: 29-30, Jan.-Feb. 1944.

8. *San Marino:* **Huntington Botanical Garden**

Est. 1905 — 200 acres

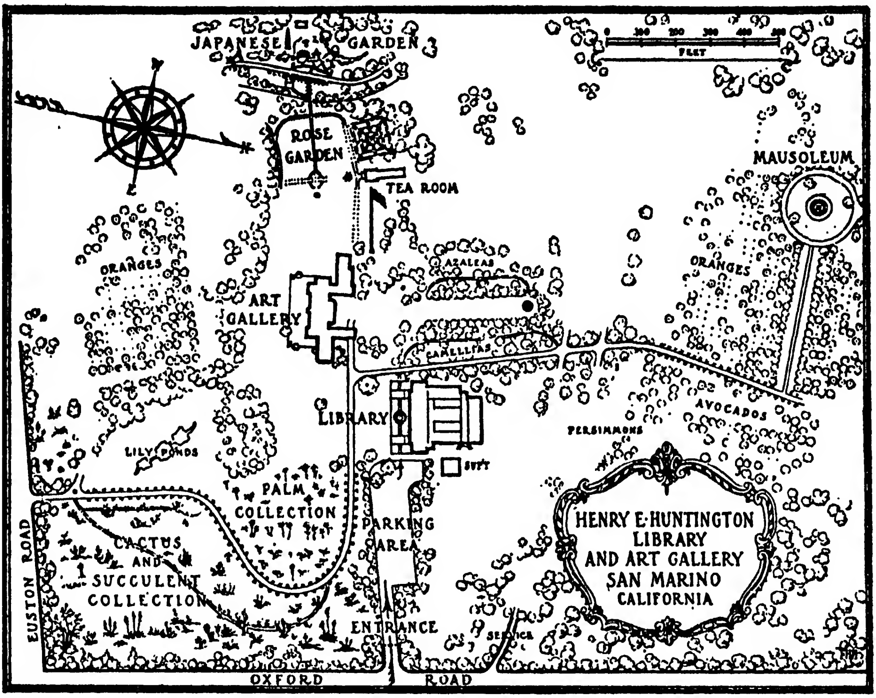
Chief functions: Educational.

This garden is a portion of the estate of HENRY E. HUNTINGTON which originally embraced 600 acres of rolling land overlooking the San Gabriel valley. Mr. HUNTINGTON was originally interested in railroad activities and in the inter-urban transportation system in the Los Angeles area. He amassed a great library of rare books and manuscripts and an art collection both of which are on display in his former home — now the Huntington Art Gallery, surrounded by the botanical garden property. THOMAS GAINSBOROUGH's famous "Blue Boy" is among the other excellent portraits by eighteenth century artists on display here. Mr. HUNTINGTON became greatly interested in plants and amassed an extensive collection of xerophytic types such as cacti, aloes, yuccas, agaves and mesembryanthemums, as well as non-xerophytics such as palms, cycads, eucalypti, acacias and plants from the orient.

Particular attention has been given to acclimatizing plants from arid and semi-arid countries. This interesting garden, library and art gallery are administered by a trust whereby five trustees are given full responsibility of administering "For the people of California."

Featuring: Succulents, evergreens, woody trees and shrubs — Conifers, sub-tropical ornamentals.
Species and vars.: 7,000 to 8,000.
Ownership: Trust.

Admission free and open to public from 1 p.m. to 4:30 p.m. daily except Mondays. — Closed during month of October.
Director: Executive committee. — *Employees:* 28.
Propagating house: 1.
Library: 4,000 vols.
Special events: Educational tours are conducted.
Publication: Cactus garden guide (1940).
Reference: "The Huntington Botanical Gardens" by Wm. Hertrich, Curator, Parks and Recreation 24, No. 12: 557-561, Aug. 1941.



9. *Santa Barbara:* **Santa Barbara Botanic Garden**[1]

Est. 1926 — 40 acres

Chief functions: Exhibition of native California plants in landscape settings.

On the outskirts of Santa Barbara in scenic Mission Canyon, this garden is situated in a region rich in native vegetation. Its chief function is not only to exhibit native California plants but also to carry on experimental studies in the use of native California plants. Many interesting natives are well displayed. The director has made a special contribution to Horticulture with his extensive studies of the genus *Ceanothus* and his book "Trees of Santa Barbara". Easily one of the beauty spots of southern California, the display of wild flowers growing in their natural habitat here is one of great interest to all conservationists.

Featuring: Perennials, woody trees and shrubs, *Ceanothus, Mimulus, Eriogonum* and others.
Species and vars.: About 800.
Ownership: Santa Barbara Botanic Garden, Inc.
Endowment: $370,000. — *Operating budget:* $24,000.
Admission free and open to public at all times.
Director: Maunsell Van Rensselaer. — *Employees:* 8.
Library: 800 vols. — *Garden Herbarium* of material grown.

[1] Formerly Blaksley Botanic Garden.

Special events: Guided tours conducted and lectures given for the benefit of the public.
Publications: Descriptive pamphlet issued — "Leaflets of the Santa Barbara Botanic Garden" — serial publication.
Reference: "Santa Barbara Botanic Garden" by MARY JANE LAWRENCE, Parks & Recreation 25, No. 3: 103-109, Nov. 1941.

— *COLORADO* —

10. *Buffalo Creek:* **Glenmore Arboretum**

Est. 1933. — 50 acres

Chief functions: Ascertaining the hardiness for Colorado use of various evergreens, and collecting native woody plants for arboretum purposes.

This is an outstanding attempt by a private individual to test the hardiness of conifers and their habits in a region where little has been done in this respect with ornamental exotics. Of course considerable information is available about the native forest flora of the area but the growing and studying of a wide variety of coniferous evergreens at an altitude of 7000 feet in the Rocky Mountain area (just north of Denver) with annual minimum temperatures of —25° to —35° F. is a commendable project from which much new information can be expected.
Featuring: Evergreens, native woody trees and shrubs.
Species and vars.: 325.
Ownership: ROBERT E. MORE, 1210 First National Bank Building, Denver.
Admission free and open to public by appointment.
Director: ROBERT E. MORE.
Plant breeding!
Library: 100 vols.
Special events are conducted for the benefit of the public.
References: "Glenmore Arboretum at Buffalo Creek" by R. E. MORE, Arnoldia 5: 65-76, Dec. 1945.

— *CONNECTICUT* —

11. *New Haven:* **Marsh Botanical Garden, Yale University**

Est. 1900 — 12 acres

Chief functions: Botanical investigation and research.
Featuring: Evergreens, woody trees and shrubs.
Species and vars.: 1500.
Ownership: Yale University.
Endowment: $2000. — *Operating budget:* $10,000.
Admission free to public and open at all times.
Director: Prof. E. W. SINNOTT.
Service greenhouses: 2. — *Employees:* 2.
Plant Breeding!

12. *New London:* **Connecticut Arboretum at Connecticut College**

Est. 1931 — 180 acres

Chief functions: Educational, extension of the College campus, distribution of native material for civic planting projects.
Featuring: native evergreens, native woody trees and shrubs — *Rubus, Solidago.*
Species and vars.: about 500.
Ownership: Connecticut College for Women.
Operating budget: About $4,000.
Admission free and open to public at all times.
Director: Dr. RICHARD H. GOODWIN. — *Employees:* 2.
Garden herbarium of material grown: about 7,000 specimens of native plants, only some from Arboretum.
Publications: Descriptive pamphlet (1941). — Serial publication: "Bull. Conn. Arboretum".
References: Bull. Conn. Arboretum, No. 4, 1941, No. 1, 1934 (Jan.), No. 2, 1935 (May).

—*DISTRICT OF COLUMBIA*—

13. *Washington:* **National Arboretum**

Est. 1927, by Act of Congress — 395 acres; purchase of approx. 14 additional acres pending.

Functions: A national, not local, institution. At present in process of preparatory physical development. When finally equipped and staffed, functions, as set forth in 1947 Statement of Scope and Objectives, recommended by Advisory Council and approved by Secretary of Agriculture, will include botanical, horticultural and forestry research and public education with respect to economic and ornamental hardy outdoor trees and shrubs (excluding economic fruit-bearing trees and shrubs) and maintenance of a living collection of such trees and shrubs; clearing house and information center for all arboretums and botanical gardens; cooperative plant breeding studies, plant identification studies for standardization of plant nomenclature; testing for optimum planting, growth, and reproduction conditions of plants as individuals; maintenance of inventories of rare trees and shrubs that are native or are in other arboretums or similar institutions; distribution to public institutions and commercial growers of initial stocks of new and rare plants; seasonal displays of flowering shrubs and trees; supplying study facilities; and publication of research results.

Ownership: United States Government. Administered by Secretary of Agriculture through the Agricultural Research Administration and Bureau of Plant Industry, Soils, and Agricultural Engineering.

Acting Director: B. Y. MORRISON. — National Arboretum Advisory Council establishment by Congress and composed of 16 citizens appointed by the Secretary of Agriculture to advise and make recommendations to Secretary on policies and operations. FREDERIC P. LEE, Bethesda, Maryland, Chairman; and C. G. WOODBURY, Washington, D. C., Secretary.

Income: Annual appropriations by Congress. Pending appropriation legislation for fiscal year 1947-48 proposes $350,000 for initial step in program for development of physical facilities and $86,900 for interim personnel and operating expenses.

Admission: Because of incomplete facilities not yet open to general public except by appointment.

References: "Our National Arboretum and its Relation to AABGA" by KNOWLES A. RYERSON, Parks and Recreation, 25, No. 12; 441-2, July-August 1942. — "The National Arboretum" by ALMA CHESTNUT, Nature Magazine 13, No. 4, April 1929. — "The National Arboretum" by GEORGE SUDWORTH, Forest Worker 2, No. 2, March 1927. — "Hearings before the Subcommittee on Agriculture of the Committee on Appropriations H.P. 80th Congress, 1st Sess.," on Department of Agriculture Appropriation Bill for 1948, Part I, pp. 800-805, 2031-3 Part 2, pp. 216-21.

14. *Washington:* **National Botanic Garden**

Est. 1820 by the Columbian Institute for the Promotion of Arts and Sciences

Owned by U. .S. Government.

Controlled by United States House and Senate Committees on Library of Congress.

—*FLORIDA*—

15. *Coconut Grove:* **Fairchild Tropical Garden***

Est. 1938 — 83 acres

Chief functions: To grow all the plant material, both native and exotic which will thrive in this area.

Named after Dr. DAVID FAIRCHILD of Coconut Grove, Florida, distinguished scientist, plant explorer and former head of the Bureau of Plant Introduction, U. S. Department of Agriculture, this garden is one of the few in the United States where tropical plants are grown for public display. It was made possible as a result of the energetic efforts of Colonel and Mrs. ROBERT H. MONTGOMERY of Coconut Grove who donated some of their land to initiate the project.

Much local and national interest has been created in this garden in recent years by an energetic board of directors, by the establishing of the Liberty Hyde Bailey

* Old Cutler Road, Box 407.

Palmetum and by the growing of many of the newer plants which Dr. FAIRCHILD has collected in the regions of the South Pacific. This great garden with its splendid group of active friends, undoubtedly has a great future ahead of it, and though not yet ten years old, can rank with the country's most important botanical gardens and arboretums.

Featuring: Palms and other tropical trees, vines and shrubs adaptable to South Florida. — 260 species of palms and cycads, 400 of trees and shrubs, 100 vars. of vines.
Ownership: Joint ownership Fairchild Tropical Garden and Dade County, Florida.
Operating budget: $15,000.
Admission free to public except palm museum to which 25 cents admission is charged.
Director: ROBERT H. MONTGOMERY. — *Employees:* 7.
Plant breeding!
Library: 1000 vols.
Special events: Flower shows presented and lectures given occasionally.
Publications: Descriptive pamphlet in preparation. — Serial publications: Bulletins and occasional papers.
Reference: "Fairchild Tropical Garden" by PAULINE CORLEY, Parks & Recreations 25, No. 7: 282-285, Mar. 1942.

16. *Homestead:* University of Florida Subtropical Experiment Station*
Est. 1930 — 170 acres

Chief functions: Research.
Another of the large state experiment stations worthy of mention in this directory because of its large collection of sub-tropical fruits. There are only a very few places where collections of such plants are grown out of doors in this country.
Species and vars.: 1050.
Ownership: State of Florida.
Operating budget: $35,000 plus sales.
Admission free and open to public at all times.
Director: GEORGE D. RUEHLE. — *Employees:* 16.
Plant breeding!
Library: 300 vols. — *Garden herbarium* of material grown.

17. *Vero Beach:* McKee Jungle Gardens
Est. 1931 — 80 acres

Chief functions: Botanical garden for display and education.
Though a commercial enterprise, the large collection of tropical and sub-tropical plants on display here make this garden worthy of mention in this directory.
Featuring: evergreens, palms, woody trees and shrubs, vines, orchids.
Species and vars.: Over 2000.
Ownership: ARTHUR G. MCKEE.
Admission: $1.20 for adults. Open to public at all times.
Director: EDWARD M. BECTON. — *Employees:* 15.
Service greenhouses: 9.
Library: 100 vols.
Plant breeding!
Publication: Descriptive pamphlet (1947).

18. *Winter Park:* The Mead Botanical Garden†
Est. 1940 — 55 acres

Chief functions: Educational and scientific.
Featuring: Orchids and other tropical plants — *Cattleyas.*
Ownership: Non-profit, self-perpetuating Corporation.
Operating budget: $8,000.
Admission: 50 cents.
Director: WILLIAM TEAS.

* Rt. 2, Box 508.
† 930 Camellia Avenue.

Display greenhouses: 4. — *Service greenhouse:* 1.
Library: 150 vols.
Special events: Orchid show, Camellia show, etc.
Publication: Descriptive pamphlet issued.

— *IDAHO* —

19. *Moscow:* Charles Huston Shattuck Arboretum, School of Forestry University of Idaho

Est. 1910 — 15-20 acres

Chief functions: Education.
Featuring: Woody trees and shrubs.
Species and vars.: About 150.
Ownership: University of Idaho.
Admission free to public and open at all times.
Director: M. E. DETERS, Professor of Forestry.
Special events: Occasional group tours are conducted.

— *ILLINOIS* —

20. *Chicago:* Garfield Park Conservatory*

Est. 1907 — 4½ acres

Chief functions: Educational.

This is easily one of the outstanding conservatories in the country if not the world. Its large size, wide range of plant material and energetic staff have made it one of the best and most interesting. Mr. AUGUST KOCH was for many years in charge of this large collection of exotics and did much to bring it to its present perfection. There are eight exhibition houses in the conservatory and each house is planted with those plants which will grow best under the same general conditions. The palm house itself is 85 feet high and permits such specimens as the sugar palm with thirty foot leaves, to be displayed to splendid advantage.

There are 125 species and varieties in the fernery, truly a splendid collection. Being in the center of a large urban area several flower shows are arranged at different times of the year to maintain the popular interest. Sometimes as many as 25,000 plants are grown especially for one show.

The old idea that a collection of plants is the ultimate goal of a municipal conservatory has been supplanted by the modern view that the opportunity for displays that will aid in the advancement of horticultural knowledge are of far greater importance. The staging of certain types of gardens, even though restricted as to area are more appealing and interesting to visitors than mere plant collections. Public relations through talks, radio and newspaper advertising, are carefully cultured. This great Conservatory is very much a part of the horticultural life of the community where it is located.

Featuring: exotics chiefly, 100 palms, 700 specimen desert plants, 500 orchids, 125 ferns.
Species and vars.: Approx. 5,000.
Ownership: Chicago Park District.
Admission free and open to the public at all times.
Display greenhouses: 8 (79,300 sq. ft. floor area).
Service greenhouses: 17 (55,700 sq. ft. floor area).
Director: WILLIAM C. BLAESING, Chief Horticulturist. — *Employees:* 55.
Plant breeding!
Library: 150 vols.
Special events: 4 major flower shows conducted: Azalea, Easter and Spring, Chrysanthemum, Christmas and mid-winter.
Publication: Descriptive pamphlet.
References: "Garfield Park Conservatory — Chicago" by FRANK K. BALTHIS, Nat. Hort. Mag. 15, No. 3; 188-195, July 1936. — "Garfield Park Conservatory, Chicago" by J. G. ESSON, Garden. Chron. Am. 49: 262, Oct. 1945.

* 300 N. Central Park Avenue.

21. *Lisle:* **Morton Arboretum**
Est. 1922 by Mr. Joy Morton — 835 acres

Chief functions: Educational.

This Arboretum, established by Mr. Joy Morton, whose father, J. Sterling Morton, founded Arbor Day, is another of the complete collections of woody plants in North America. The objective here has been to grow a specimen of every woody plant that will live out of doors in this somewhat difficult climate of the midwest. Good soil, intelligent management and proper care have enabled the plants to "grow up" fast. Now splendid plantings of all the important trees and shrubs are easily seen. Space has not been a limiting factor so that in many collections it has been possible to plant large groups of a particularly important variety, rather than one specimen.

The rolling hills, the lakes or ponds and the natural woods combined with a carefully planned road system lead the visitor to many interesting spots. An excellent formal hedge demonstration plot is a feature of the planting immediately at the rear of the Administration Building.

Recently the Board of Trustees has become very interested in the educational possibilities of this arboretum, and considerable emphasis is now being placed on the establishing of clearly marked nature trails and the education of the children, both through classes for the children themselves and for their teachers. In fact the entire staff of this institution has been engaged in this phase of public education. Lectures, walks, tours, photographic contests and numerous ways of interesting pupils as well as their teachers in the plants of the arboretum have been intelligently conceived and cleverly executed. Much information can be obtained from the Morton Arboretum concerning the methods it is using in this important phase of public education.

Featuring: Evergreens, woody trees and shrubs, 150 hedges, 100 ground covers, and a garden of old fashioned roses containing 285 varieties. As complete a collection of every genus as possible.

Species and vars.: Approximately 5,000.

Ownership: Board of Trustees.

Admission free and open to public at all times.

Director: C. E. Godshalk. — *Arboriculturist:* E. Lowell Kammerer. — *Employees:* 22.

Library: 5,000 vols. — *Garden herbarium* of material grown.

Special events: Photographic contests and classes in gardening, nature study, and landscape architecture are conducted for the benefit of the public.

Publications: Descriptive pamphlet (1947). — Bulletin of Popular Information (serial publication). — Map, published in 1943.

Reference: "The Morton Arboretum" by E. L. Kammerer, Parks & Recreation 24, No. 9: 426-432, May 1941.

22. *Lombard:* **Lilacia Park**
Est. 1929 — 9 acres

Chief functions: Education.

Featuring: Perennials (tulips), shrubs (lilacs).

Species and vars.: lilacs 300 or more, tulips 100 or more.

Ownership: Lombard Park District.

Operating budget: $7,500 to $8,000.

Admission free to public except during lilac-tulip show when fee of 25 cents plus 5 cents tax is charged.

Director: Charles S. Michaels, President of Park District.

Publication: Descriptive pamphlet.

— *INDIANA* —

23. *Huntington:* **Huntington College Botanical Garden and Arboretum**
Est. 1935 — 40 acres

Chief functions: Educational and research.

Species and vars.: 632.

Ownership: Huntington College.

Admission free and open to public at all times.

Director: Fred A. Loew.

Publication: Annual reports of Huntington College, Botanical Garden and Arboretum, Tenth (Dec. 1945).
References: "A Botanical Garden and Arboretum", Chronica Botanica 4, No. 2: 161, April 1938. — "Botanic Gardens of the World" by C. STUART GAGER, Brooklyn Botanic Garden Record 27, No. 3: 364, July 1938. — "Huntington College Botanical Garden and Arboretum" by FRED A. LOEW, Parks & Recreation 30, No. 5: 227-228, May 1947.

24. *Indianapolis:* **Butler Botanical Garden, Butler University**
Est. 1928 — 15 acres

Chief functions: To provide for the study of living plants and interest in the cultivation of rare forms.
Featuring: Perennials, annuals, woody trees and shrubs.
Species and varieties: About 5000.
Ownership: Butler University.
Admission free and open to public at all times.
Plant breeding!
Publication: Descriptive pamphlet (1936).

25. *Muncie:* **Christy Woods** (formerly Ball Arboretum)
Est. 1918 — 18 acres

Chief functions: A biological laboratory.
Featuring: Annuals, woody trees and shrubs.
Species and varieties: 210.
Ownership: State of Indiana.
Operating budget: $2555.
Admission free to public and open from 7 a.m. to 4:30 p.m. every day except Sundays.
Director: O. B. CHRISTY, Head, Department of Science, Ball State Teachers College.
Publications: Descriptive pamphlet. — Ball State Teachers College Bulletin.
References: "An Outdoor Laboratory at Ball State Teachers College" by O. B. CHRISTY, Sept. 1939.

— *IOWA* —

26. *Ames:* **Iowa State College Arboretum**
Est. 1934 — 74 acres

Chief functions: Educational, research, extension.
Featuring: Evergreens, woody trees and shrubs. — ***Juniperus.***
Species and vars.: 266.
Ownership: Iowa State College.
Director: Prof. R. R. ROTHACKER
Library: 15,350 vols. in field of botany, horticulture, forestry, landscape architecture.

— *KANSAS* —

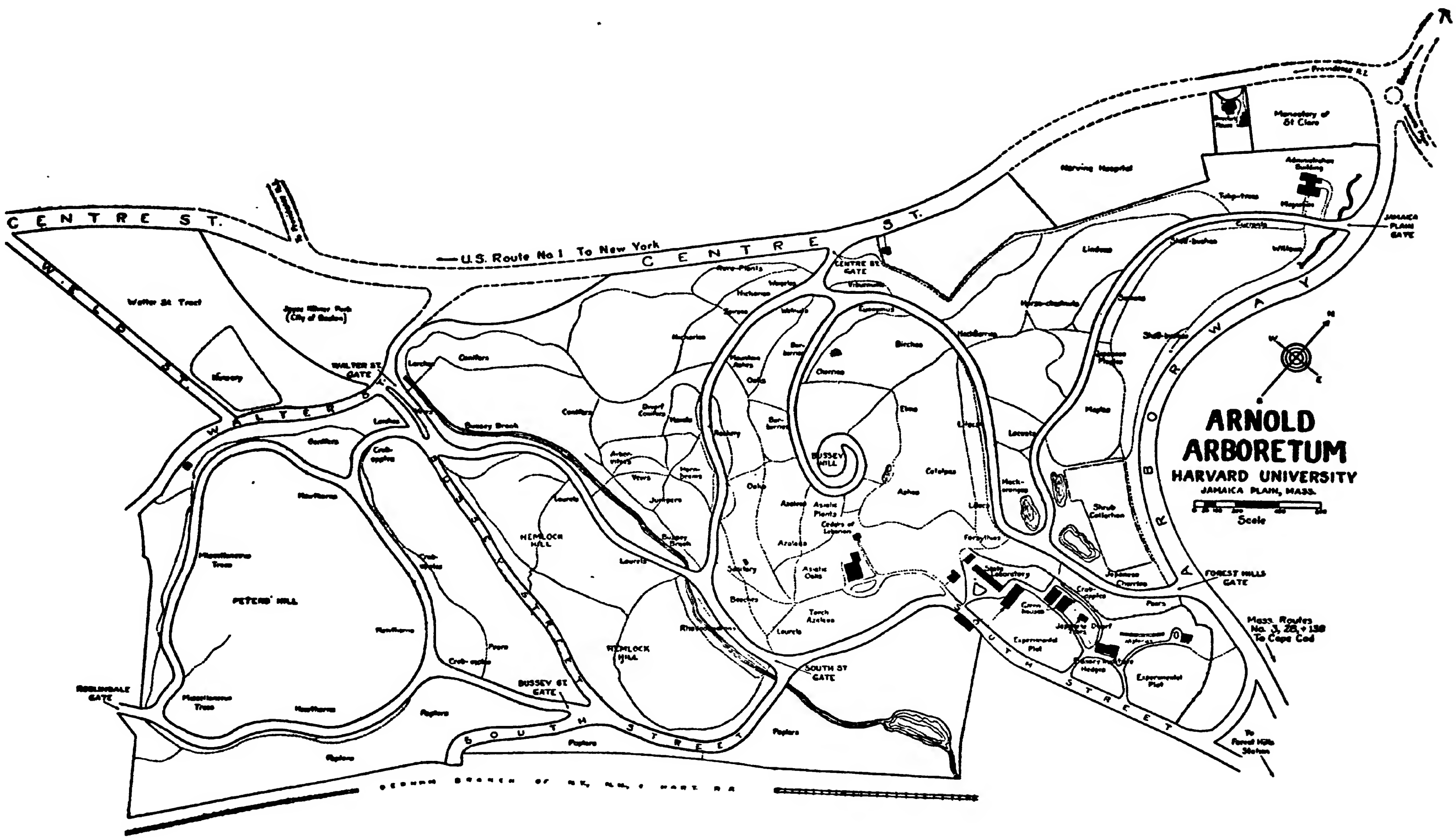
27. *Topeka:* **Indian Hill Arboretum**
Est. 1933 — 100 acres

Chief functions: Educational.
Featuring: woody trees and shrubs, pines, lilacs, oaks, junipers, and thorns.
Species and vars.: 500.
Ownership: KARL and JEANETTA MENNINGER.
Open to public by invitation only.
Director: Dr. KARL MENNINGER.

— *LOUISIANA* —

28. *Avery Island:* **McIlhenny Arboretum**
Est. 1900 — 300 acres

Chief functions: Park and bird sanctuary.
Featuring: Evergreens, woody trees and shrubs.
Ownership: E. A. McILLHENNY.


ARNOLD
ARBORETUM
HARVARD UNIVERSITY
JAMAICA PLAIN, MASS.
Scale
CENTRE ST.
U.S. Route No 1 To New York
CENTRE ST.
WELD ST.
WALTER ST.
BUSSEY STREET
SOUTH STREET
ARBORWAY
CENTRE ST GATE
WALTER ST. GATE
BUSSEY ST GATE
SOUTH ST GATE
FOREST HILLS GATE
JAMAICA PLAIN GATE
ROSLINDALE GATE
BUSSEY HILL
HEMLOCK HILL
PETERS' HILL
Walter St. Tract
Nursery
Bussey Brook
Administration Building
Harvard Hospital
Monastery of St Clare
Shrub Collection
Mass. Routes No. 3, 28, + 138 To Cape Cod
To Forest Hills Station

Admission charge: $1.20 per person. Open every day in the week including Sundays from 8 a.m. to 5 p.m.
Service greenhouses: 2.—*Employees:* 75.
Plant breeding!
Publication: Descriptive pamphlet (1941).

—*MAINE*—

29. *Bar Harbor:* **Reef Point Gardens**
Est. 1939 — 6 acres

Chief functions: Display of small collection of trees, shrubs and perennials suited to the climate and soil in this area.
Featuring: Perennials, annuals, evergreens, woody trees and shrubs — chiefly ericaceous plants.
Species and varieties: About 1000.
Ownership: BEATRIX FARRAND.
Admission free and open to public at all times.
Service greenhouse: 1.—*Employees:* 4.
Director: BEATRIX FARRAND and ROBERT W. PATTERSON.
Library: About 1000 vols.
Special events: Garden Club meetings, and conducted tours.
Publications: Reef Point Gardens Bulletin, Vol. 1, No. 1, 1946.

—*MASSACHUSETTS*—

30. *Jamaica Plain:* **Arnold Arboretum,** Harvard University
Est. 1872 — 415 acres

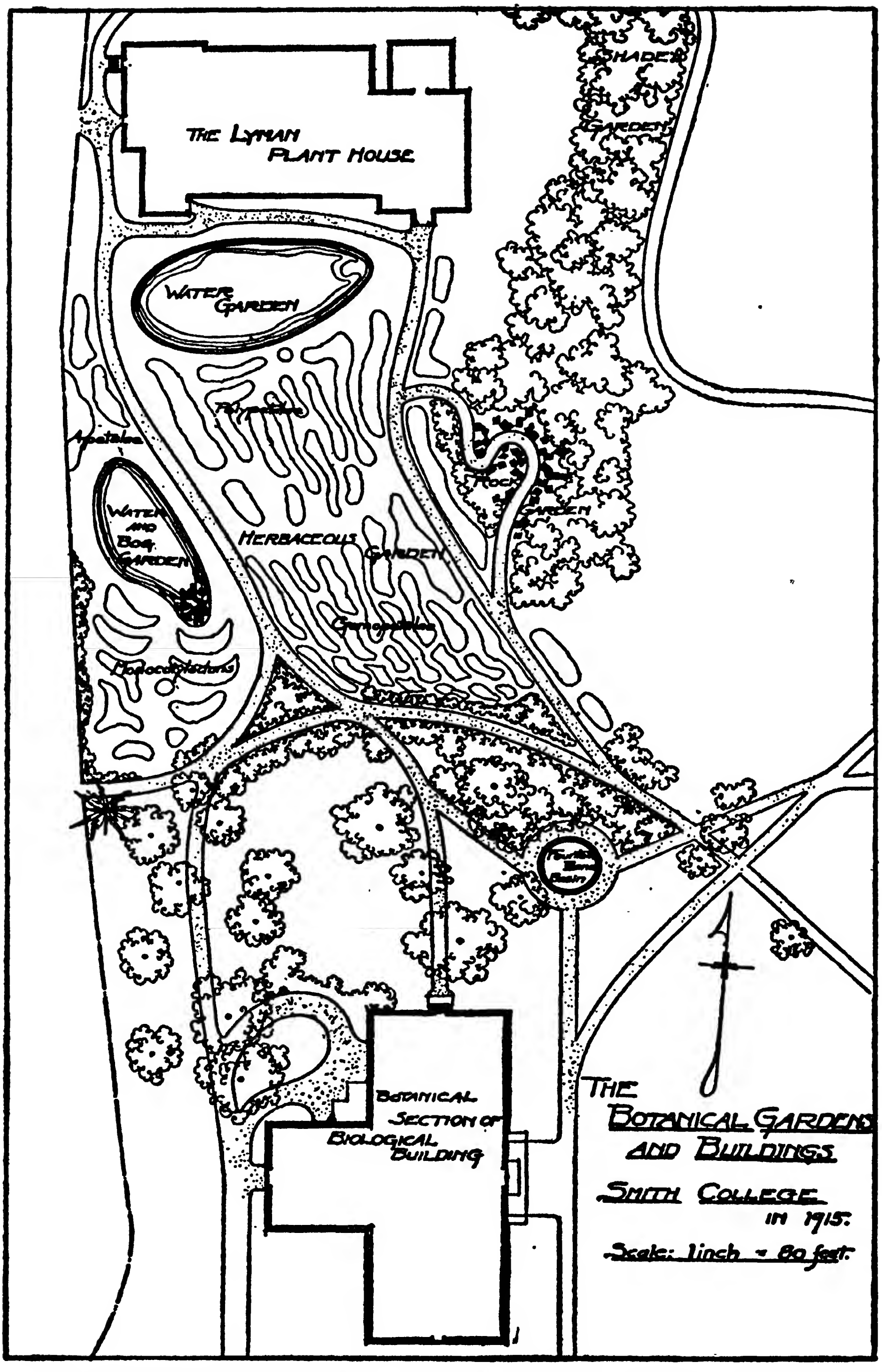
Chief functions: Research, education, display.

For seventy-five years the Arnold Arboretum has been actively introducing new woody plants into American gardens. This has caused it to become one of the largest trial grounds for ornamental woody plants. Almost all the emphasis is placed on woody plants. There are no strictly formal gardens here. Informal plantings of various kinds of shrubs and trees vie with the larger collections of plants like lilacs and azaleas for the interest of the casual visitor. Studies are constantly being made concerning new and better varieties as comparisons are made with older types.

The great library, started by Professor CHARLES SPRAGUE SARGENT many years ago is still a very important feature, visited by students from all over the world. The great herbarium is a mecca for botanists interested in ornamental woody plants, especially in those from the Orient. More recently research work has been done in plant pathology and plant breeding.

The long list of plants for which the arboretum is responsible for introducing started in the 1870's with the then unknown Japanese barberry, since become one of our common garden plants. The publications of its first director, C. S. SARGENT, are standard as are those of ALFRED REHDER, for many years Curator of the herbarium, and the accomplishments of E. H. WILSON for many years a staff member of the arboretum, are feats well known everywhere. Now, the great plantings are still as beautiful as always, but strenuous efforts are being taken to keep only the best ornamentals on prominent display, the mediocre types being grown in the background or else being removed to a "reference" collection, where they will have good care and always be available for those who want to observe them, but where they will not take up valued space needed for better specimens.

Featuring: Evergreens, woody trees and shrubs—*Malus, Syringa, Philadelphus, Rhododendron,* hedges, woody vines.
Species and vars.: 6,000.
Ownership: Harvard University.
Endowment: $3,500,000.—*Operating budget:* $90,000.
Admission free and open to public from sunrise to sunset.
Service greenhouses: 3.—*Employees:* 25.
Acting Director: Dr. KARL SAX.—*Horticulturist:* Dr. DONALD WYMAN.
Plant breeding, plant propagation, taxonomic botany!
Library: 45,000 vols.—*Garden herbarium* of material grown as well as a large herbarium of 500,000 sheets of woody plants from all over the world.
Special events: Popular classes and tours conducted.



Of the college and university botanical gardens in North America, the Smith College Gardens at Northampton, Mass. (*cf.* p. 433) exercised a world-wide influence owing to the advanced views of its long-time director, the late Professor W. B. Ganong, who wrote widely on his botanico-educational philosophy and managed (as so few of us are able to do) to materialize his views in the biological laboratory, gardens, and the famous Lyman Plant House at Smith College. The above plan shows the gardens in 1915, a short time after their completion. Since then much has, of course, been added, as an enlargement of the rock garden, a large group of conifers, a brook garden, etc. In addition to the publications mentioned on pages 433 and 479 we should still like to refer to two other stimulating papers by Dr. Ganong, "The Botanic Gardens of Smith College, a Study of an Educational Adaptation" (Garden and Forest 10:512-514), and "The New Laboratory and Greenhouse for Plant Physiology at Smith College" (Science 15:933-937).

Publications: Descriptive pamphlet (1934). — Serial publications: "Arnoldia," "Sargentia," etc.

References: "America's Greatest Garden" by E. H. Wilson, Stratford Co., Boston, 1935. — "The First Fifty Years of the Arnold Arboretum" by C. S. Sargent, Journal of the A.A. 3, No. 3, 122-171, Jan. 1922. — Through the Arnold Arboretum, 1934 (pamphlet). — The Arnold Arboretum and its Future, 1927 (pamphlet). — "The Past Year at the Arnold Arboretum" by Donald Wyman, Arnoldia 7, No. 1: 1-8, March 21, 1947. — Many bulletins and magazine articles by various staff members.

31. *Lexington:* **Lexington (Mass.) Botanic Garden, Inc.***
Est. 1932 — 11 acres

Chief functions: To grow and test hardy herbaceous plants.
Featuring: perennials — *Iris, Primula, Sedum, Phlox, Saxifraga, Hemerocallis.*
Species and vars.: 3000.
Ownership: Lexington (Mass.) Botanic Garden, Inc.
Admission free and open to the public at all times.
Director: Prof. Stephen F. Hamblin.
Publication: "Lexington Leaflets" — serially.

32. *Northampton:* **Smith College Arboretum**
Est. 1893 — 173 acres

Chief functions: Educational.
Featuring: Succulents, perennials, annuals, evergreens, woody trees and shrubs.
Species and vars.: Approx. 3500.
Ownership: Smith College.
Director: William I. P. Campbell. — *Employees:* 8.
Admission free and open to the public at all times.
Plant breeding!
Library: approx. 5,000 vols. — A *garden herbarium* of material grown.
Special events: Conduct spring bulb display in March, Chrysanthemum display in November.
References: Brooklyn Botanic Garden Record Vol. 27, No. 3: 373, 1938. — Zoological Parks, Aquarium and Botanic Gardens, publication of American Association of Museums, 59, new series No. 12, 1932. — "Economic Plants Popular at Smith College" by William I. P. Campbell, Parks & Recreation 27, No. 1: 26-29, Jan.-Feb. 1944.

33. *South Sudbury:* **Garden in the Woods**
Est. 1932 — 30 acres

Chief functions: To bring together all the native plants hardy in this latitude and to carry on experiments with their propagation and cultivation.
Featuring: Native plants (wild flowers).

The collection embraces native plant material, brought together from all over the country, from the Atlantic to the Pacific, Alaska and the southern mountains and a comprehensive group of true alpines, both eastern and western, in especially prepared places.

Species and vars.: More than 2000.
Ownership: Will C. Curtis and Richard H. Stiles.
Admission free to public and open from sunrise to sunset.
Director: Will C. Curtis.

34. *Wellesley:* **Alexandra Botanic Garden and Hunnewell Arboretum†**
Wellesley College
Est. 1923 — 24 acres

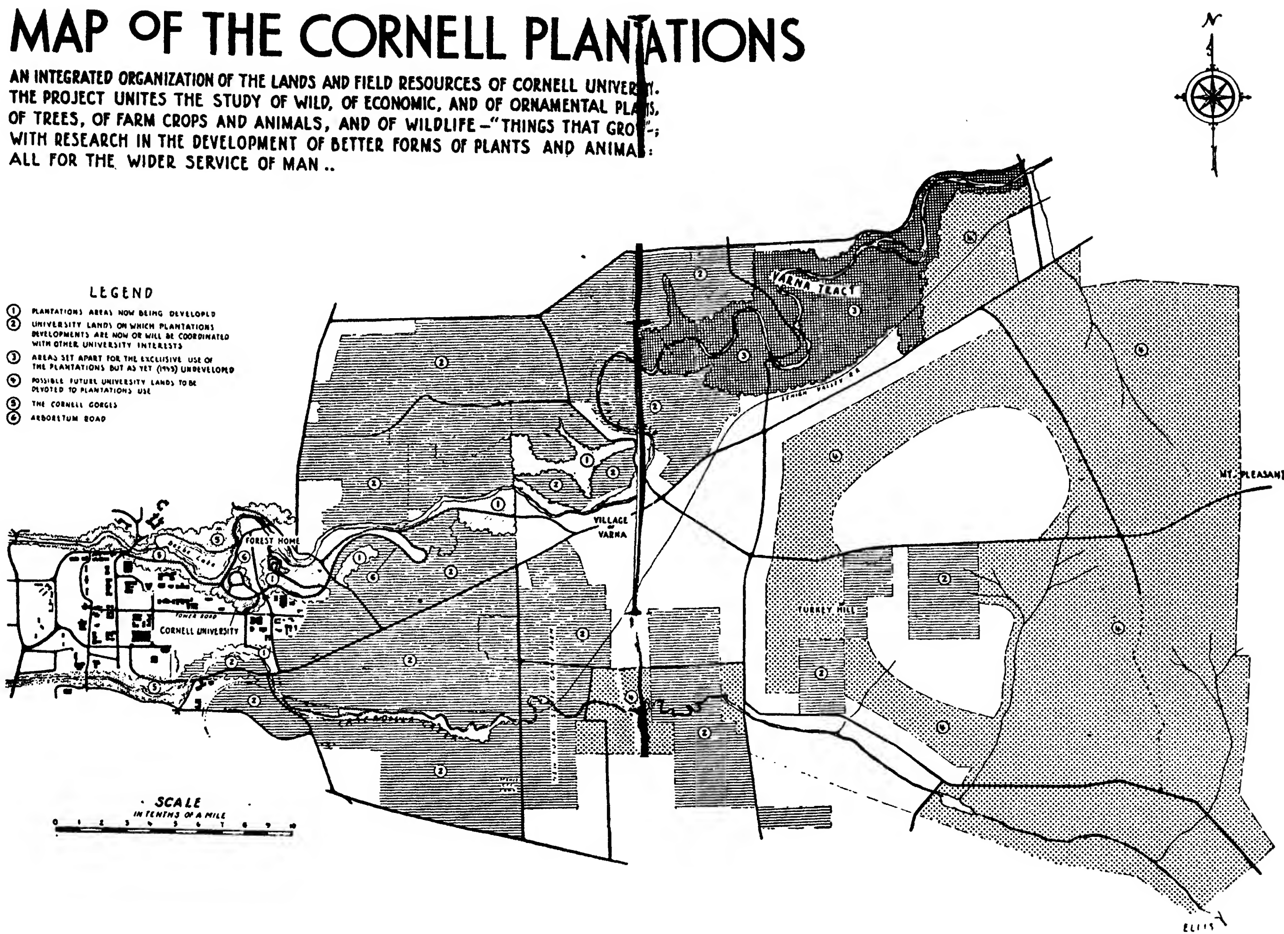
Chief functions: Educational.
Featuring: Evergreens, woody trees and shrubs.

* 91 Hancock Street.

† This is not to be confused with the much older and larger, privately owned Walter Hunnewell Arboretum (formerly known as the H. H. Hunnewell Arboretum) which borders the Wellesley College Campus.

MAP OF THE CORNELL PLANTATIONS

AN INTEGRATED ORGANIZATION OF THE LANDS AND FIELD RESOURCES OF CORNELL UNIVERSITY. THE PROJECT UNITES THE STUDY OF WILD, OF ECONOMIC, AND OF ORNAMENTAL PLANTS, OF TREES, OF FARM CROPS AND ANIMALS, AND OF WILDLIFE—"THINGS THAT GROW"; WITH RESEARCH IN THE DEVELOPMENT OF BETTER FORMS OF PLANTS AND ANIMALS: ALL FOR THE WIDER SERVICE OF MAN..



Species and vars.: About 1,000.
Ownership: Wellesley College, administered by Board of Directors.
Endowment: $60,000. — *Operating budget:* $2400.
Admission free and open to public at all times.
Display greenhouses: 5. — *Service greenhouses:* 1.
Director: Dr. Harriet Baldwin Creighton.
Plant breeding!
Library: 9,127 vols.

35. *Wellesley:* Walter Hunnewell Arboretum*

Est. 1851 - - 40 acres
(formerly the Arboretum of H. H. Hunnewell)

Featuring: Conifers and Rhododendrons.

One of the oldest collections of conifers in the East, many of the trees are older and larger than those in the Arnold Arboretum. Originally this collection was started by Mr. H. H. Hunnewell and now is owned by his son who is also very interested in these plants and Rhododendrons as well. One of the interesting features of the grounds is a group of trees which have been maintained in a clipped condition for many years. These topiary specimens are unique in this part of the country. Among other plants Hatfield's yew originated in this arboretum.
Ownership: Walter Hunnewell.
Director: John Ellis.
References: "The Pinetum at Wellesley", Garden and Forest, August 17, 1892: 385-386.

— *MICHIGAN* —

36. *Ann Arbor:* Nichols Arboretum, University of Michigan

Est. 1907 as Botanic Garden, 1916 as Nichols Arboretum — 126 acres

Chief functions:
1. Exhibition of material usable in landscape architecture.
2. Testing hardiness and tolerance of ornamental plants.
3. Habitat studies.
4. Landscaping and planting composition.

Featuring: Peonies, evergreens, woody trees and shrubs.
Species and vars.: 1,800-2,000 including native plants.
Ownership: University of Michigan, Dept. of Landscape Architecture.
Admission free and open to public at all times.
Director: Prof. Harlow O. Whittemore. — *Employees:* 5.
Library: 2,500-3,000 volumes.
Publications: Guide maps. — Lists of plants, etc. — Various newspaper and magazine articles.

37. *Hillsdale:* Slayton Arboretum and Botanical Garden

Est. 1922 — 75 acres

Chief functions: Educational, recreational, testing ground.
Featuring: Perennials, evergreens, woody trees and shrubs — *Malus, Syringa.*
Species and vars.: 1400.
Ownership: Hillsdale College.
Operating budget: $1,000.
Admission free and open to public at all times.
Director: Prof. Bertram A. Barber of Hillsdale College. — *Employees:* 1-4.
Special events: Musical concerts are conducted on Sundays in August.
Publications: General descriptive booklet. — Plant index.
Reference: "Botanical Gardens of the World" by C. Stuart Gager, Brooklyn Botanic Garden Record 27, No. 3: 378, July 1938.

* 845 Washington Street.

— *MINNESOTA* —

38. *Minneapolis:* **Eloise Butler Wild Flower Garden** in Theodore Wirth Park
Est. 1907 — approx. 31 acres

Chief functions: To provide the means of seeing almost all of the flowers and plants indigenous to Minnesota in their aboriginal beauty and in a comparatively small area.
Featuring: Wild flowers and plants of Minnesota, in more than 1000 varieties, 50 varieties of ferns, 100 different kinds of birds have been observed in the garden.
Ownership: Board of Park Commissioners, City of Minneapolis.
Admission free and open to public from April 1st to October 1st.
Curator: Mrs. MARTHA CRONE.
Special events: The curator guides groups or individuals through the garden, informally or by appointment.
Publication: Descriptive pamphlet.
Reference: "Our Native Plant Preserve, Theodore Wirth Park (Glenwood Park) now called 'Eloise Butler Wild Flower Garden'" by Mrs. JOHN H. JEPSON (mimeographed).

39. *Northfield:* **Carleton College Arboretum**
Est. 1922 — 360 acres

Chief functions: Aid in teaching landscape art, forest botany, biology, and proving ground for Upper Mid-west woody materials.
Featuring: Woody trees and shrubs.
Species and vars.: 340.
Ownership: Carleton College.
Operating budget: $3,100.
Admission free and open to public at all times.
Director: H. E. STORK. — *Employees:* 2.
Special events: Guided nature trail in spring, other guided parties on request.

— *MISSOURI* —

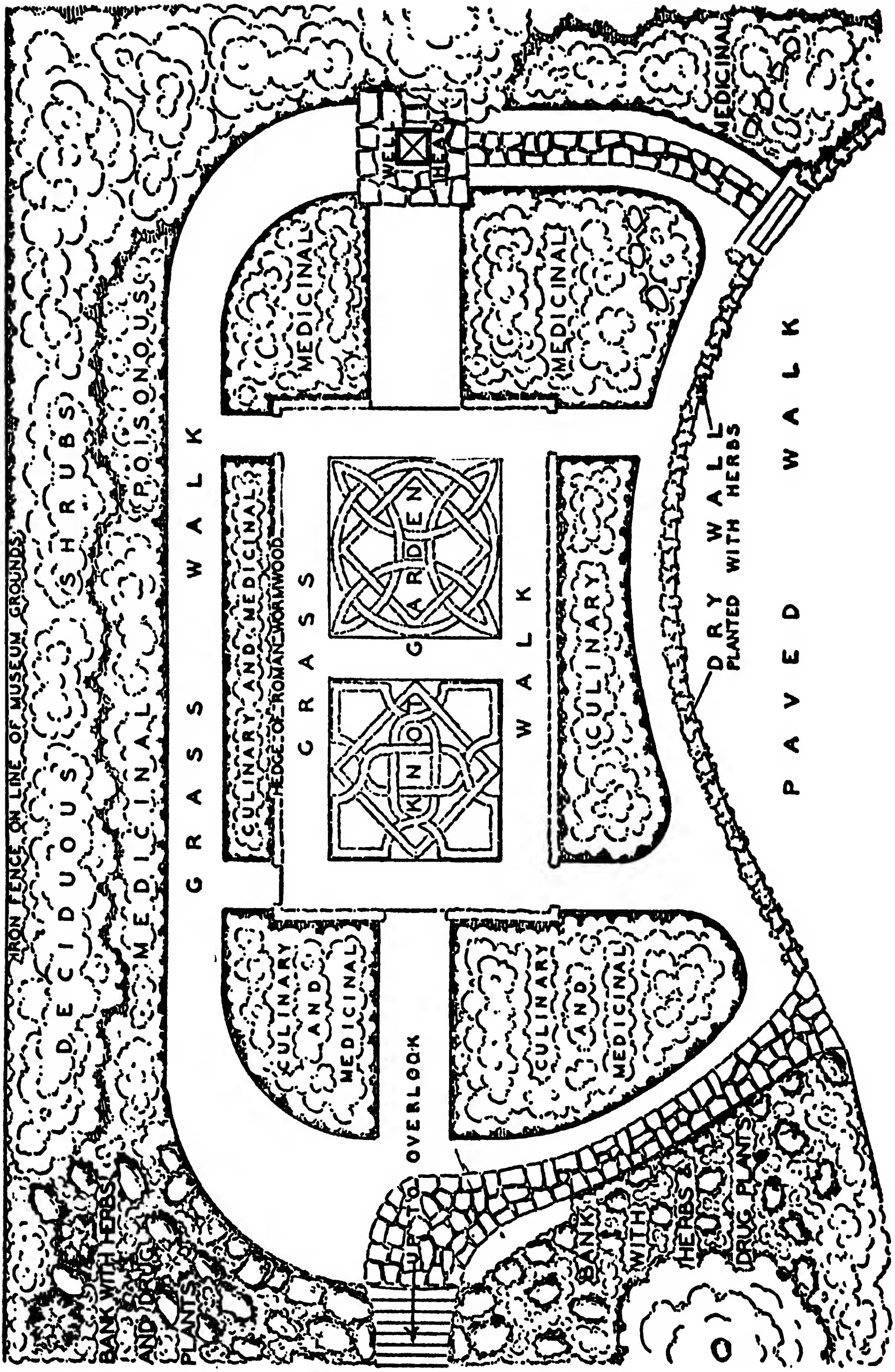
40. *St. Louis:* **Missouri Botanical Garden**
Est. 1890 by HENRY SHAW — 75 acres, St. Louis; 1600 acres, Gray Summit

Chief functions: Scientific and educational.

Formerly the home of HENRY SHAW, a prosperous St. Louis merchant, the Missouri Botanical Garden has become much more than a private country home in the fifty-seven years of its existence. At first it displayed interesting plantings about the grounds and original dwelling house, but as it obtained more and more specimens it fast became the world famous institution that it is today. The large conservatories in St. Louis serve for displaying the many exotic greenhouse plants as well as afford perfect staging for the weekly flower shows given during the course of the year. The Garden is operated almost entirely on income derived from the original Shaw Estate, and is not aided by city or state.

The original garden is unfortunately situated in a city where the smoke problem is a particularly perplexing one. Plants growing out of doors have had a most difficult time, so that it has been necessary, in order to prepare for expansion, to purchase a large tract of land about thirty-five miles west of the city, where smoke does not retard plant growth. Here an arboretum is becoming established and here is situated the great orchid range, for the Garden has been interested in the culture of orchids for some time. The vast collection comprises some 20,000 orchid plants, one of the largest in the world. The blooms from this great range prove most interesting to the general public when displayed in flower shows at the conservatories of the Garden in St. Louis.

Mention should also be made of the splendid collection of water lilies here, for much pioneer work is done with their culture and breeding in this Garden. Considerable scientific research also is carried out here in plant breeding, mycology, taxonomy and paleobotany. Visitors to St. Louis will undoubtedly remember with



THE HERB GARDEN OF THE BROOKLYN BOTANIC GARDEN

pleasure any of the great flower displays they have been privileged to see in this great midwestern botanical garden.
Featuring: Succulents, evergreens, woody trees and shrubs.
Species and vars.: 12,000.
Ownership: Board of Trustees (a charitable trust).
Endowment: \$5,000,000.00. — *Operating budget:* \$150,000-\$200,000.
Admission free and open to public at all times except Christmas and New Year's 8:30 a.m. to 5:00 p.m. Sundays 10 a.m. to 5 p.m.
Director: Dr. GEORGE T. MOORE. — *Employees:* 75.
Plant breeding!
Library: 57,317 vols., 98,147 pamphlets.
A *garden herbarium* of material grown, as well as from all over the world.
Special events: Floral displays under glass, *Chrysanthemum,* orchid, spring flower shows, etc. Course for amateurs in horticulture and plant breeding. Lectures to garden clubs, etc.
Publication: Descriptive pamphlet (1947). — Serial publications. — Monthly "Bulletin" and quarterly "Annals" (scientific).
References: "Arboricultural Development in the Missouri Botanical Garden", Parks & Recreation 5, No. 5: 264-270, Jan. 1932. — "The Missouri Botanical Garden" by GEORGE T. MOORE, Parks & Recreation 25, No. 2: 67-72, Oct. 1941. — "The Missouri Botanical Garden" by HENRY N. ANDREWS, Jr., Parks & Recreation 29, No. 5: 297-302, Sept.-Oct. 1946.

— *NEBRASKA* —

41. *Nebraska City:* **Arbor Lodge State Park Arboretum**

Est. 1903 — 63 acres

Chief functions: Education and recreation.
Featuring: Evergreens, woody trees and shrubs.
Species and vars.: About 150.
Ownership: State of Nebraska.
Admission charge: 10c — open to public April 1st to November 1st, from 1:30 p.m. to 5 p.m.
Director: GRANT MCNEEL, Supt. — *Employees:* 5 to 7.
Special events: Tours are conducted through the mansion.
Publication: Guide book (1932).

— *NEW JERSEY* —

42. *New Brunswick:* **Arboretum of Horticultural Farm,** New Jersey Agricultural Experiment Station

Est. 1896 — 30 acres

Chief functions: Research and education.
Featuring: perennials, woody trees and shrubs — *Rhododendron* and kin — *Ilex* being assembled.
Species and vars.: *Iris,* 700 vars.; peony, 100 vars.; chrysanthemums, 300-400 vars.; 450, shrub garden; 250, ericaceous garden.
Ownership: Trustees of Rutgers College in New Jersey and State of New Jersey.
Admission free to public during business hours and on certain specially designated Sundays and holidays.
Director: Dr. C. H. CONNORS. — *Employees:* 3 to 8.
Special events: Special field days on designated Sundays and holidays.

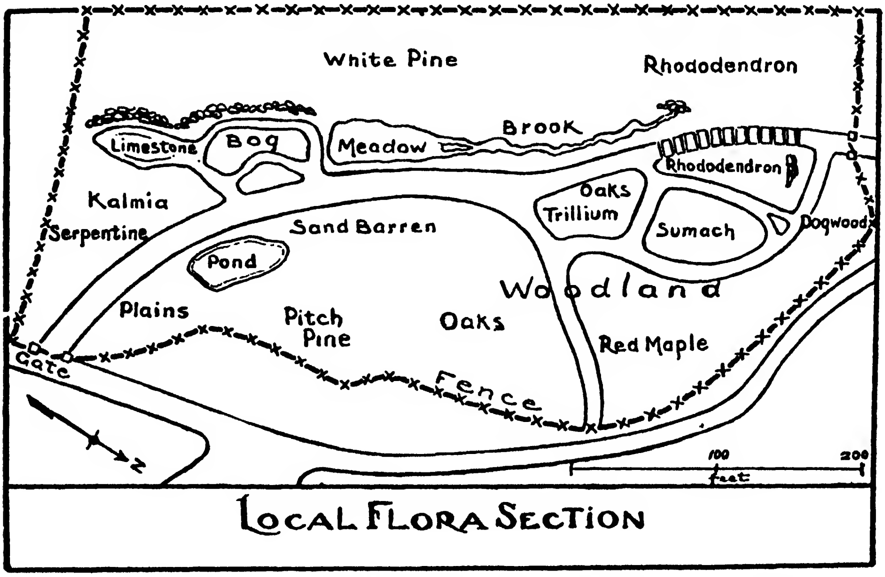
— *NEW YORK* —

43. *Brooklyn:* **Brooklyn Botanic Garden**

Est. 1910 — 50 acres

Chief functions: (*1*) To maintain a living labeled plant collection out-of-doors and in the greenhouses for the benefit of the public. Also a herbarium of more than 200,000 plant specimens. — (*2*) To conduct an educational program of botanical and horticultural courses for adults and children. Classes are open to members of the Garden, and others upon payment of nominal fee.

This botanic garden, situated in the heart of a great city, has been doing a splendid work in child and adult education. Its staff members have contributed much scientific information to our knowledge of plants and their culture, but this particular garden will be highly thought of by all those urban dwellers with whom it has come in contact, for its interest in teaching horticulture and the lore of growing plants. No botanic garden could be in more difficult environs, yet, possibly because of this, the Brooklyn Botanic Garden continues to render the people of Brooklyn a real service in teaching them to appreciate plants and their culture.



WITHIN THE BROOKLYN BOTANIC GARDEN a number of small, special gardens, as "Local Flora Garden" (map above), "Rock Garden", "Rose Garden", and "Herb Garden" (map on a previous page) have been developed under the late Dr. GAGER's able leadership. Unusually well written guides to each of these gardens have been published, in the course of the years, in the *Brooklyn Botanic Garden Record*.

Featuring: Trees and shrubs.
Ownership: The Brooklyn Institute of Agriculture and Sciences, a private corporation. Operating on land and in structures belonging to the city of New York. Plant collection, library, herbarium and all scientific equipment is the property of the Corporation.
Endowment: $1,600,000. — *Operating budget:* $190,000.
Admission free and open to public at all times from sunrise to one half hour after sunset.
Display greenhouses: Numerous. — *Service greenhouses:* 2.
Director: Dr. GEORGE S. AVERY, Jr. — *Employees:* 60.
Plant breeding!
Library: Approx. 25,000 vols., 25,000 pamphlets. — *Herbarium:* 250,000 sheets.
Special events: Numerous but particularly for members.
Publications: "Brooklyn Botanic Garden Record" (serial); "Genetics" and "Ecology" (serials); "Brooklyn Botanic Garden Contributions" (serial); "Plants and Gardens" — a popular quarterly magazine of horticulture, occasional leaflets, annual reports, articles in several publications both popular and scientific.

44. *Buffalo:* Buffalo Botanical Garden*

Est. 1894 — 155 acres

Chief functions: Education and research.
Featuring: Succulents, collection of tropical and semi-tropical plants, drug plants.

* South Park Avenue and Buffalo City Line.

Species and vars.: 700.
Ownership: City of Buffalo.
Admission free and open to public at all times.
Supt. of Parks: Louis H. Neubeck. — *Employees:* 26.
Display greenhouses: 16 (75,000 sq. ft.). — *Service greenhouses:* 6.
Plant breeding!

45. *Farmingdale:* **Long Island Agricultural and Technical Institute**
Est. 1930 — 14 acres

Chief functions: Educational.
Featuring: Perennials, annuals, evergreens, woody trees and shrubs.
Species and vars.: 1,400.
Ownership: New York State.
Admission free and open to the public at all times, Monday through Friday 8 a.m. to 5 p.m., Saturday 8 a.m. to 12 noon.
Director: Dr. Halsey B. Knapp.
Library: 1000 vols.
Special events: Garden Week.

46. *Geneva:* **New York State Experiment Station**
Est. 1900 — 150 acres

Chief functions: Agricultural research — horticulture. Primarily the collections are maintained for fruit breeding purposes.

This Experiment Station is included in this directory because it is one of the great collections of fruit varieties amassed for scientific study and comparison. There is a small collection of ornamental woody plants also grown, but the main interest is centered around the collections of fruits. It must be said in all fairness to other state and federal experiment stations in this country and also to the governmental experiment stations in Canada, that some of them too are worthy of note. Because of its wide variety of fruits, this station at Geneva was selected to exemplify the group. Its collections of strawberries, bush fruits, stone fruits and apples and pears (as well as many others also) affords excellent opportunity for fruit comparisons. The work it has done in the past especially under the direction of Dr. U. P. Hedrick, has made it world famous.

Featuring: Woody trees and shrubs — all fruits.
Species and varieties: Collection of all temperate zone species of fruits and varieties.
Operating budget: $100,000 for horticulture.
Admission free and open to public at all times during working hours 8 a.m. to 5 p.m.
Director: Dr. A. J. Heinicke. — *Employees:* 150.
Plant breeding!
Library: 10,000 vols.
Special events: Frequent meetings of horticulturists and nursery organizations, fruit growers, etc.
Publications: Station pamphlet (1942); "Farm Research" — quarterly; Research bulletins; Popular bulletins; Many articles for scientific and horticultural periodicals; Books — many important treatises on various kinds of fruits written by staff members.

47. *Ithaca:* **Cornell Plantations, Cornell University**
Est. 1935 — 1200 acres

Chief functions: Education, research, and wild life sanctuary.

This arboretum and botanic garden is the culmination of years of discussion and planning originated by Dr. Liberty Hyde Bailey at the beginning of the century. It is an interesting cooperative plan, whereby the various agricultural departments of the University will pool some of their land and amalgamate their interests in such a way that a unified arboretum and botanical garden, of use to all, will eventually result.

Though hampered by lack of maintenance funds at present, the general over-all plan has been made, much work has been done in the establishment of a system of trails and roads by former Civilian Conservation Corps camps and some planting has been accomplished. When sufficient funds do become available for ideal maintenance,

this beautiful natural spot on the border of scenic Lake Cayuga may well become one of this country's outstanding university arboretums.
Featuring: Evergreens, woody trees and shrubs — *Juniperus.*
Ownership: Cornell University.
Admission free and open to public at all times.
Director: Plantations Committee, Dr. L. H. BAILEY, *Chairman*, Dr. L. H. MACDANIELS, Exec. Chairman.
Special events: Test gardens.

THE
NEW YORK
BOTANICAL GARDEN

Bronx Park, New York City

OFFERING

Flower displays, outdoors and in the conservatories, all the year around.

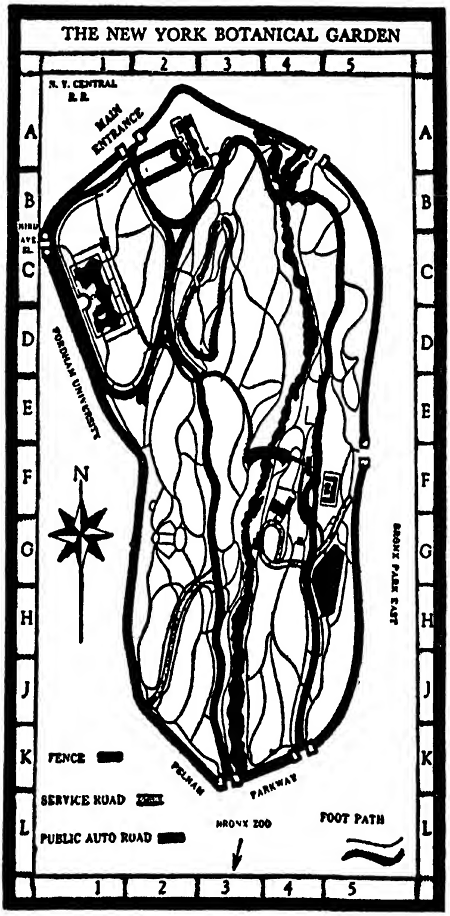
Natural woodland areas bordering the Bronx River.

Plantings of hardy ornamental trees and shrubs from many parts of the world.

Museum exhibits, library, herbarium, courses for gardeners and nature students, lectures, radio programs, and information on topics concerning botany and horticulture.

Open to the public without charge every day in the year

Telephone: SEdgwick 3-3200



TWO PAGES (SLIGHTLY REDUCED) FROM A SIX PAGE FOLDER ABOUT THE NEW YORK BOTANICAL GARDEN.

Publications: Serial — "The Cornell Plantations" (quarterly).
References: "The Cornell Plantations, A History" by RALPH S. HOSMER, Administrative Committee, Cornell Plantations, 1947, 209 pages, $3. — "The Cornell Arboretum" by NELSON MILLER WELLS, Parks & Recreation 25, No. 5: 193-199, Jan. 1942.

48. *New York City:* **New York Botanical Garden**
Est. 1896 — 235 acres

Chief functions: Education, research, entertainment, recreation and instruction.

This great scientific institution is actively engaged in fulfilling the pressing needs — as far as plant education and research go — of a great urban metropolis. Its display

greenhouses, formal beds, Thompson Rock Garden and various scientific exhibits are all carefully presented to the public to promote an interest in and an appreciation of plants. Lectures, tours and classes for adults all are part of the program. The great herbarium and library are constantly in use by students from all fields. The Garden is affiliated with Columbia University and staff members give courses in botany for candidates for advanced degrees.

Features of Special Interest

(To locate these places on the map, follow the letters in from the left or right margin and the figures from the upper or lower margin.)

ANNUAL FLOWERS (C-1). Colorful borders containing 175 kinds of annuals, all labeled, northeast of the main conservatory. *Late June-Oct.*

ASTERS (C-1). One hundred varieties of hardy asters (Michaelmas daisies) selected and hybridized from native American species. *Sept.*

AZALEAS (H-J-2-3). A new woodland planting covering approximately 10 acres when completed. *May.*

BOULDER BRIDGE (B-4). One-way automobile route to the Rose Garden, Experimental Garden, Propagating Range, Nursery, Service Building, and Snuff Mill.

CHERRIES (J-K-2). Many varieties of ornamental flowering cherries. Individual specimens in other parts of the grounds. *April, May.*

CHRYSANTHEMUMS (C-1). A magnificent display of nearly 100 varieties. *Early Oct. until heavy frost.*

CONSERVATORIES (C-D-1). Notable collections of ornamental and botanically interesting plants. *Open every day in the year, 10 to 4:30.*

DAHLIAS (B-1). More than 500 of the finest varieties in a border near the conservatories. *Sept., Oct.*

DAYLILIES (A-3, F-4). More than 200 named horticultural clones and species of Hemerocallis in the Experimental Garden, also back of the Museum Building, being used for breeding and demonstration. *June, July* (Aug., Sept.).

FALLS BRIDGE (F-3-4). Pedestrian bridge, on the route to the Rose Garden, overlooking the picturesque gorge of the Bronx River.

FLOWERING MEADOW (D-2-3). An area at the southern end of the Rock Garden where many native plants and others have been naturalized, giving a season-to-season picture of flowers as though in the wild. *April-Oct.*

HEMLOCK FOREST (C-3-G-4). Called "New York's most precious natural possession." Forty acres on the banks of the Bronx River, traversed by several miles of paths.

HERBS (C-1). Annual and perennial plants that can be used for food, flavor, and fragrance. *June-Sept.*

HOLLIES (C-1). A collection of English hybrids, rare in this country, in the Conservatory Court. *Dec., Jan.*

IRIS (B-C-1). Bearded iris, Japanese, Siberian, and bulbous in 300 varieties, besides 40 natural species. *Late May and June.*

LILACS (B-1). Twenty species and more than 100 varieties bordering the path north of the conservatories. *Apr.-June.*

MAGNOLIAS (B-C-4-5). A group of flowering trees at the edge of the woodland on the east side of the grounds. *May-June.* (July-Aug.).

Privileges of Membership

Free participation in study courses up to the amount of the annual membership fee paid.

A subscription to the monthly Journal.

A subscription to Addisonia, issued annually.

A share of the plants made available for free distribution.

The right to borrow lantern slides.

Invitations to special displays, conferences, and programs, and free announcements also of broadcasts, lectures, and motion pictures.

Use of the Members' Room, also the Library and Herbarium.

Free conference with staff members on problems in botany and horticulture.

Identification of plant material.

A Membership Card which serves as admittance at special functions, such as the Members' Day programs, and identifies the bearer at similar institutions in other cities.

* * * * *

Membership is welcomed from those who wish to support the work of the New York Botanical Garden, as well as from those whose chief interest lies in utilizing the privileges. Garden Clubs may become affiliated as a unit with the Botanical Garden.

* * * * *

Inquiries about membership or affiliation should be addressed to:

THE NEW YORK BOTANICAL GARDEN
Bronx Park, New York 58, N. Y.

This form may be used in requesting information.

Please send information on:

Legal Form for Gifts and Bequests ☐	Publications ☐
Individual Membership ☐	Courses ☐
Garden Club Affiliation ☐	Free Programs ☐
	Broadcasts ☐

Name. . . . .

Address. . . . .

. . . .

Two other pages from the New York Botanical Garden's well arranged, informative and compact six page folder (*continued from previous page*).

Annual flower displays are always attended by thousands. The great conservatories are always a source of interest to young and old alike. Many important contributions have been made to taxonomic botany by the many staff members. More recently research in plant breeding and plant physiology is taking an increasing amount of the time of staff members. If one looks over the imposing array of scientific serial publications originating at the New York Botanical Garden and visits its vast plant, one begins to feel a little of the great responsibility for public education carried by this one institution, the largest of its kind in America.

Featuring: Representatives of all plant groups maintained.
Species and varieties: 12,000.
Endowment: $3,500,000. — *Operating budget:* $400,000.
Admission free and open to public at all times.
Director: Dr. WILLIAM J. ROBBINS. — *Horticulturist:* T. H. EVERETT. — *Employees:* 150.
Plant breeding and research in plant physiology!
Library: 53,000 vols. — *Garden herbarium* of material grown as well as a large one of plants from all over the world.
Publications: Descriptive pamphlet (1947); Journal of the New York Botanical Garden; "Mycologia"; "Brittonia"; "North American Flora"; "Addisonia"; "Bulletin of the New York Botanical Garden."
References: "Through the Garden Gate," Journal 1, No. 1, Feb. 1946. — Significance of Plants in War and Peace," New York Botanical Gardens, 1945-46. — "New York Botanical Garden" by WILLIAM J. ROBBINS, Parks & Recreation 24, No. 7: 290-296, Mar. 1941. — "A Guide to the Pinetum" by E. H. FULLING, New York Botanical Garden Bull. 51, 1929.

49. *Newburgh:* **Thomas C. Desmond Arboretum**
Est. 1939 — 45 acres

Chief functions: Native American trees and shrubs which prove hardy.
Featuring: Woody trees and shrubs.
Species and vars.: 553.
Ownership: THOMAS C. DESMOND.
Endowment: $2,500,000.00. — *Operating budget:* $25,000.
Admission free to public at all times.
Director: RUDOLPH M. NOOKER. — *Employees:* 5.
Library: 3,000 vols.
Reference: "The Desmond Arboretum" by ALBERT J. ABRAMS, Parks & Recreation, 27, No. 1: 30-34, Jan.-Feb. 1944.

50. *Rochester:* **Highland and Durand-Eastman Park Arboretum,** Rochester Parks Department
Est. 1890 — 600 acres

Chief functions: Educational and recreational.

In Highland Park, and the larger Durand-Eastman Park, Rochester, New York, has one of the country's leading arboretums. The 484 acres constituting Durand-Eastman Park was originally a gift to the city, made by Dr. HENRY S. DURAND and GEORGE EASTMAN. Maintenance operations are carried out exclusively by the City Park Department. The modifying temperature supplied by Lake Ontario, on which this park borders, affords excellent conditions for the growth of splendid specimen conifers, one of the features of this park. Here are growing one of the best collections of *Malus* and *Prunus* in the North. The former superintendent, B. H. SLAVIN, is largely responsible for the excellent plantings as they are found today.

In Highland Park, Rochester has featured its lilac collection. Here more lilac plants are grown than in any other collection in North America. During lilac week alone more than 200,000 people visited this extensive collection. In fact some of the best lilac varieties we have today originated in this famous collection, the result of the painstaking work of JOHN DUNBAR, the former propagator of the Rochester Park System. The collection of *Magnolias* and tree peonies is also meritorious.

Rochester, known as a center for nurseries and general interest in plants, is reasonably proud of its public-supported arboretum. Civic pride has done much to increase the beauty of the city by much planting on private property. A drive down East Avenue in May is a real treat. Other municipalities could do well to study and emulate what civic groups have done in Rochester, New York, in order to make their parks and their private gardens, more attractive through intelligent planting.

Featuring: Evergreens, woody trees and shrubs — *Syringa, Malus,* coniferous evergreens.
Species and vars.: Over 4,000.
Ownership: City of Rochester.

Admission free and open to public at all times.
Display greenhouses: 3. — *Service greenhouses:* 5.
Director: PATRICK J. SLAVIN. — *Superintendent:* WILLIAM PITKIN. — *Employees:* 30.
Herbarium of material grown.
Special events: Lilac Week, floral displays, group tours.
References: "Rochester in Lilac Time" by ELISABETH KEIPER, The Flower Grower, 32, No. 5: 255-256, 272-273, May 1945. — "Lilacs, Peonies and other collections in Highland Park" by HELEN CRESSWELL ELLWANGER, Bulletin Garden Club of America, No. 14, 17th series: 58-65, Mar. 1941. — "List of Lilacs in Rochester Parks," Report of 1941 Survey by JOHN WISTER "Lilacs of America," Am. Ass. of Bot. Gard. & Arb. — "Crabapples of America" by DONALD WYMAN, Report of July 1943 Survey, Am. Assoc. of Bot. Gard. and Arb.

51. *Sloatsburg* (Rockland County): **Skylands Nursery**
Est. 1921 — 40 acres

Chief functions: Experimental, testing and growing of ornamental plants.
Featuring: Perennials, evergreens, woody trees and shrubs.
Ownership: CLARENCE LEWIS.
Admission free to persons interested but being a private enterprise permission should be obtained in advance.
Service greenhouses: 2.

52. *Yonkers:* **Arboretum of the Boyce Thompson Institute for Plant Research**
Est. 1925 — 305 acres

Featuring: Evergreens, woody trees and shrubs.
Species and vars.: About 3000.
Ownership: Boyce Thompson Institute, Inc.
Admission: By permit for season or for specific dates.
Director: Dr. WILLIAM CROCKER. — *Superintendent:* J. H. BEALE. — *Employees:* 7.

— *OHIO* —

53. *Cincinnati:* **Mt. Airy Forest Arboretum**
Est. 1932 — 119.29 acres

Chief functions: Educational.
Featuring: Evergreens, woody trees and shrubs.
Species and vars.: 1,488.
Ownership: City of Cincinnati, Board of Park Commissioners.
Admission free and open to public at all times.
Supt. of Parks: HARRY A. GRAY.
Publication: Mimeographed guide (1942).

54. *Cincinnati:* **Stanley M. Rowe Arboretum***
Est. 1930 — 144 acres

Featuring: Evergreens, woody trees and shrubs.
Species and vars.: 2,500.
Ownership: Mr. and Mrs. STANLEY M. ROWE.
Admission free and open to public at all times.

55. *Columbus:* **The Dawes Arboretum†**
Est. 1929 — 325 acres

Chief function: Education.

This includes a group of trees planted as memorials, each one of which has a bronze tablet erected by it, commemorating the military individual or the distinguished person who was asked to plant the tree.

Featuring: Woody trees and shrubs.
Species and vars.: 1050.
Admission free and open to public from sunrise to sunset.

* R.R. No. 1.
† Office: 620 East Broad Street, Columbus, Ohio.

Director: D. H. MULLONEY. — *Employees:* 6.

The Arboretum is located thirty-two miles East of Columbus, approximately two miles North of Jacksontown which is on the National Highway (U.S. Route No. 40).

56. *Kirtland Hills:* The Holden Arboretum
Est. 1930 — 450 acres

Chief function: Education.

This is one of the young arboretums of the country situated in the suburbs of Cleveland. It has a very energetic board of control and some of the best plantsmen in the country are actively interested in it. The planting at present is young and modest, but well laid plans are being made so that when its funds do become available it may well become one of the most outstanding arboretums in the country.

Featuring: Woody trees and shrubs — *Syringa, Forsythia, Viburnum, Prunus, Malus, Magnolia, Rosa* species.

Species and vars.: 1200.

Ownership: A trust administered by the Cleveland Museum of Natural History.

Operating budget: $8,500.00.

Admission free only during seasons when displays are best.

Director: A Board of Control under Cleveland Museum of Natural History. — *Employees:* 3.

Special events: Conducted tours at special seasons.

Publication: Map (1947).

57. *Wooster:* Wooster Arboretum
Est. 1909 — 75 acres

Chief functions: Research and education.

Featuring: Evergreens, woody trees and shrubs — *Taxus,* chiefly forest plantings.

Species and vars.: 675.

Ownership: State of Ohio.

Admission free and open to public from sunrise to sunset.

Director: EDMUND SECREST (until Dec. 31, 1947), L. L. ROMMEL (thereafter). — *Employees:* 3-4.

— *PENNSYLVANIA* —

58. *Elizabethtown:* Masonic Home Arboretum
Est. 1910 — 50 acres

Chief functions: Education and beautification of property.

The Grand Lodge of Free and Accepted Masons of Pennsylvania uses this property and about 1150 acres in addition as a Masonic Home. The grounds have been beautifully landscaped and a remarkably extensive collection of ornamentals has been built up over a period of years.

A Memorial Oak Grove of about five acres, a Beech Grove of one and a half acres, an Elm Grove, a Linden Grove, several Pine Groves and a big planting of Bald Cypress are among the features. A formal garden with about 2,000 roses in several hundred varieties and approximately 5,000 perennial plants add to the beauty of this restful spot.

To show what has been done in the way of plant acquisition, there were only about 300 different kinds of plants on the property in 1930, now there are ten times that many, creating a real and diversified interest in the plantings. Considerable information can be obtained here of specimens which prove only partly hardy in New England. Not known as much as it deserves this arboretum and botanic garden is well worth a visit.

Featuring: Hardy cacti, perennials, annuals, evergreens, woody trees and shrubs — *Ilex, Syringa.*

Species and vars.: 3279 (391 conifers, 281 broad leaved evergreens, 1452 other trees and shrubs, 1131 perennials and rock garden plants, 24 bamboos).

Ownership: Committee on Masonic Homes.

Operating budget: $15,000.

Admission free and open to public until 5 p.m. every day.

Director: GUSTAF E. MALMBORG. — *Employees:* 10-20.
Plant breeding (Crapemyrtles and lilies) !
Publication: "Plantings on the Masonic Homes Property" (1943).
Reference: "A Masonic Homes Garden Spot" by G. E. MALMBORG, Parks & Recreation 25, Nos. 11 & 12: 435-441, July-Aug. 1942.

59. *Harrisburg:* **Breeze Hill Garden**

Est. 1909 — 2.4 acres

Chief functions: Educational, particularly to keep the Mount Pleasant Press informed as to new advances in horticulture.

The Mount Pleasant Press, for which Breeze Hill Garden is operated, is one of this country's outstanding horticultural printers. A specialty is made of printing nursery and seed catalogues, especially with color reproductions. Paintings and photographs are made by the artists directly from the plants in this small garden. Much material is crowded in this 2.4 acres and new collections are continually being added and old ones removed. Here also the newer and "best" types are featured, one of the reasons why the Mount Pleasant Press as a printing organization is among the best in its field.

Featuring: A general collection, varying with the progress of plant origination — *Rosa*, 57 species, 888 varieties; 350 other genera, 1164 species.
Ownership: J. HORACE MCFARLAND.
Operating budget: $3,000.
Admission free and open to public with slight restriction.
Service greenhouses: 1.
Director: J. HORACE MCFARLAND.
Publications: Descriptive pamphlet (1940). — "Breeze Hill News" (serial).
Reference: "What is Breeze Hill" by J. HORACE MCFARLAND, Parks & Recreation 25, No. 6: 235-242, Feb. 1942.

60. *Kennett Square:* **Longwood Gardens**

Est. 1800 — 900 acres

Chief functions: Education and recreation.

Not only is this important because of its many interesting greenhouses and conservatories but also because of its beautifully landscaped gardens. The original tract of land known as Longwood, was conveyed by a grant from WILLIAM PENN to GEORGE PIERCE in 1702 and the original mansion built in 1730, still remains in excellent condition. Some century old trees are still standing to lend historic elegance to the plantings including a *Ginkgo biloba* three and a half feet in diameter said to be one of the original trees imported into this country.

This beautiful estate has been carefully laid out for display purposes. Formal gardens, clipped box hedges, a rose garden, a large lake and numerous fountains all combine with the informal plantings to make a well knit sequence of beautiful scenes. The electric fountain displays are unusual and people come considerable distances to see them. A generous policy of allowing certain organizations to use the open air theatre, occasionally is another privilege greatly appreciated by the public. The organ recitals in the conservatory are an added delight to many who visit the gardens primarily for this reason alone. In the words of Longwood's Superintendent "the handiwork of Nature and man's ingenuity have combined, and the result is the 'Longwood' of today, a place fully deserving the title of 'America's Greatest Estate' ".

Ownership: Longwood Foundation.
Admission free to public 11 a.m. to 5 p.m. with organ recital from 3 p.m. to 5 p.m. in the Conservatory on Sundays.
Display greenhouses:

1 for Camellias, Rhododendrons, Azaleas and Acacia, Macromata and Pulcella (26,000 sq. ft.),
6 for Nectarines, Peaches and Apricots,
1 for Main display house (18,000 sq. ft.),
1 for Tropical plants,
1 for Hibiscus,
4 for Grapes (60 vines),
1 for Fern (425 ferns),
1 for Rose (2500 plants),

2 for Figs,
1 for Amaryllis (3000), Nerines (200),
3 for Orchids,
1 for Carnation (900 plants),
1 for Cactus (36), and
1 for Melon house in four sections.

Service greenhouses: Many houses and frames are devoted to growing plants for the display houses.
Director: JOHN H. MARX, Supt. of Horticulture. — *Employees:* 57.
Publication: "The Story of Longwood" as told by RUSSELL P. BREWER, Supt. of Maintenance, Longwood Farms.

61. *Lima:* John F. Tyler Arboretum

Formerly private Arboretum of Painter Brothers, planted about 1825 to 1875 — 647 acres mostly meadow and woodland

Chief function: Restoration of Painter Brothers' planting.
Featuring: Woody trees and shrubs — unusually large specimens of *Sequoia, Cedrus libani, Picea orientalis, Cryptomeria japonica, Quercus alba, Q. macrocarpa, Q. phellos, Taxodium*, etc.
Species and vars.: 120.
Ownership: Trustees, John J. Tyler Arboretum.
Endowment: Approx. $500,000. — *Operating budget:* Approx. $15,000.
Admission free and open to public at all times.
Director: JOHN C. WISTER. — *Employees:* 3.
Library: 1000 books.
Special events: Various meetings for garden clubs and similar organizations.
References: "The Painter Arboretum and Dismal Run" by T. CHALKLEY PALMER, The Westtonian, Autumn, 1945. — "The Tyler Arboretum" by CHRISTINE C. MORLEY, Delaware County Magazine, November 1946.

62. *Merion:* The Barnes Foundation Arboretum

Est. 1923 — 12 acres

Chief function: Educational.

It should be noted that this private enterprise is doing a splendid piece of work in offering courses for adults in the practical, scientific and aesthetic phases of Botany and Horticulture. The only requirement for admission is a genuine interest in the subject as manifested by regular attendance at the classes. The Director is aided in teaching the classes by some of the best talent available from institutions in the Philadelphia area. The Barnes Foundation Arboretum thus adds materially to the scope of the arboretums of this country by adequately demonstrating how a private institution can be of a real educational service in promoting a knowledge and interest in plants on the part of the general public.

Featuring: Perennials, evergreens, woody trees and shrubs — 90 species and varieties of hardy ferns.
Species and vars.: 1,800.
Ownership: The Barnes Foundation—A. C. BARNES.
Admission free to public but only open upon request.
Service greenhouse: 1.
Library: 414 vols.
Director: Mrs. LAURA L. BARNES. — *Employees:* 14.
Special events: Classes in Botany, Horticulture and Landscape Architecture.
Publications: Descriptive pamphlet (1945). — Annual circular of classes.
References: Landscape Architecture Mag. 26, No. 1. — "Arboretum of the Barnes Foundation" by FRANK A. SCHREPFER, House and Garden 82: 54, Dec. 1942. — "The Arboretum of the Barnes Foundation," Parks & Recreation 27, No. 4: 183, July-August, 1944.

63. *Mont Alto:* State Forest Arboretum

Est. 1902 — 25 acres

Chief function: Educational.
Featuring: Woody trees and shrubs.

Species and vars.: Approx. 600.
Ownership: Pennsylvania Department of Forests and Waters.
Admission free and open to public at all times.
Director: J. E. AUGHANBAUGH, Research Forester.
Service greenhouse: 1.
Library: 3,000 vols.
Publication: Descriptive pamphlet (1947).

64. *New Hope:* **Bowman's Hill State Wild Flower Preserve** in Washington Crossing Park*

Est. 1934 — 100 acres of native woodland along Pidcock Creek

Chief functions: Educational (conservation through appreciation and education).

Those interested in wild flower conservation could learn much in this Preserve especially concerning labelling and the methods used in maintaining and protecting the various collections. It clearly demonstrates how effective a well managed cooperative effort can be in plant conservation. It was within the boundaries of this Preserve where GEORGE WASHINGTON'S army was encamped prior to the crossing of the Delaware and the Battle of Trenton. The use of an historical site such as this for a wild flower preserve shows foresight indeed and undoubtedly aids in establishing the perpetuity of the historic site as well as of the Preserve.

Featuring: Woody trees and shrubs but especially ferns, fern allies and wild flowers native to Pennsylvania.
Species and vars.: 426 species of trees, shrubs, vines and wild flowers plus 81 species of ferns and fern allies.
Ownership: Pennsylvania Department of Forests and Waters and administered by Washington Crossing Park Commission.
Sponsored by Conservation Council of Penna. A Committee of volunteers representing Garden and Women's clubs has horticultural supervision over this area.
Endowment: Yearly contributions by garden and women's clubs, etc.
Admission free and open to public at all times.
Director: Executive Committee of the Bowman's Hill State Wild Flower Preserve.
Library: 30 vols.
Publication: Free trail guide (1946).
Reference: "A Pennsylvania Preserve for Wild Flowers" by J. W. ADAMS, Parks & Recreation 24, No. 5: 222-228, Jan. 1941.

65. *Newtown Square:* **Ellis College Arboretum**

Est. 1932 — 80 acres

Chief function: Educational.
Featuring: Evergreens, woody trees and shrubs.
Species and vars.: 579.
Ownership: Ellis College for Fatherless Girls.
Admission free and open to public after presentation at office.
Director: S. MENDELSON MEEHAN.
Reference: "A New Arboretum" by S. MENDELSON MEEHAN, Parks & Recreation 26, No. 5: 227, May-June, 1943.

66. *Philadelphia* (Germantown): **Hemlock Arboretum**

Est. 1931 — 7½ acres

Chief functions: To grow and classify specimens of genus *Tsuga*.

If acreage and number of plants were the sole basis for terming a garden either an arboretum or botanical garden, this might not be so considered. On the other hand if interest, time and patience are to be considered as well as painstaking and expensive research, then the Hemlock Arboretum certainly is more than a garden. Mr. JENKINS has clearly demonstrated what important contributions a man can make to horticulture when he selects one group of plants — in this case the genus *Tsuga* — and then painstakingly goes about assimilating all the information available about them. Mr. JENKINS has gone to considerable expense to obtain and display growing specimens of

* 2½ miles south of New Hope, Bucks Co.

all the hemlocks on his estate "Far Country" and, as time goes on, this collection will become an increasingly valuable one.
Species and vars.: 9 species, 40 varieties.
Ownership: CHARLES F. JENKINS.
Operating budget: $1,000.00.
Director: CHARLES F. JENKINS. — *Employees:* 4.
Admission free and open to public at all times.
Publications: Descriptive pamphlet (Jan. 1, 1947). — Hemlock Bulletin issued quarterly.
References: "The Hemlock Arboretum at 'Far Country'" by CHARLES F. JENKINS, Parks and Recreation 25, No. 3: 110-116, Nov. 1941. — "Hemlock — The Queen of Conifers" by CHARLES F. JENKINS, Arnoldia 6, Nos. 11-12: 49-60, Dec. 13, 1946.

67. *Philadelphia:* **Horticultural Hall and Arboretum,** West Fairmount Park
Est. 1876 — 30 acres

Chief functions: Education and recreation.
Featuring: Succulents, perennials, annuals, evergreens, woody trees and shrubs; displays in conservatory known as Horticultural Hall.
Species and vars.: 644 species, 80 varieties.
Ownership: City of Philadelphia.
Admission free and open to public at all times between 9 a.m. to 5 p.m.
Employees: 20.
Display greenhouses and *service greenhouses.*
Library: 425 vols.
Special events: Floral displays.
Publications: Descriptive pamphlet, catalogue of Tender Plants (1907).

68. *Philadelphia* (Chestnut Hill): **Morris Arboretum,** affiliated with University of Pennsylvania
Est. 1933 — 160 acres

Chief functions: Education and research (woody plants).

Formerly a private estate this Arboretum is now closely affiliated with the Department of Botany, University of Pennsylvania, which is responsible for its operation. It is an excellent example of a private foundation functioning as an integral part of a great university which serves both as an educational and a research center. Its splendid old trees, fernery and hanging garden are present features of interest. Its future plans call for considerable enlargement of its present plantings. It is situated on the outskirts of Chestnut Hill, Philadelphia, in a center where much interest is taken in private gardens.
Featuring: Wall plants and ferns; evergreens; woody trees and shrubs — *Rhododendrons* and *Azaleas; Clematis* species, varieties and hybrids.
Species and vars.: 1,730.
Ownership: The Morris Foundation.
Operating budget: $47,000 annually.
Admission free and open to public from 9 a.m. to 5 p.m. daily except Christmas and New Year's Day.
Director: Dr. JACOB R. SCHRAMM. — *Curator:* HENRY T. SKINNER. — *Employees:* 20.
Display greenhouse: Fernery. — *Service greenhouses:* 4.
Plant breeding! — chiefly *Azalea, Rhododendron* and *Buxus.* Also provides office and nursery facilities for the Northeastern Forest Experiment Station of the U. S. Dept. of Agriculture for research in forest genetics and plant breeding.
Library: 2,300 vols. — *Herbarium* of woody plants.
Special events: Guided tours and lectures.
Publications: "Morris Arboretum Bulletin" (serial). — Morris Arboretum Monographs.

69. *Pittsburgh:* **Phipps Conservatory**
Est. 1893 — 2 acres under glass; 3 acres, specialized, herbaceous, horticultural (water and ericaceous gardens)

Featuring: Contains a wide variety of horticultural plants.
Ownership: City of Pittsburgh.

Operating budget: Approx. $90,000.
Admission free and open to public at all times except during the spring and fall shows.
Director: FRANK S. CURATO. — *Employees:* 29.
Display greenhouses: 13. — *Service greenhouses:* 8.
Special events: Two large annual flower shows.
Reference: "Phipps Conservatory" by J. G. ESSON, Garden Chron. Am. 50: 12, Jan. 1946.

70. *Reading:* **Botanical Garden of the Reading Public Museum and Art Gallery**
Est. 1926 — 29 acres on Wyomissing Creek

Chief function: Educational (Dept. of Visual Education).
Featuring: Perennials, annuals, evergreens, woody trees and shrubs.
Species and vars.: 1,500.
Ownership: School District of Reading, Penna.
Operating budget: $15,000.
Admission free and open to public at all times.
Head Gardener: WALTER J. HENNING. — *Employees:* 6.
Library: 500 vols.
Special events: Lilac Sunday.

71. *Swarthmore:* **Arthur Hoyt Scott Horticultural Foundation,** Swarthmore College
Est. 1930 — 250 acres

Chief function: Horticultural collections for the education of the public.

The Director, Dr. JOHN WISTER, was probably one of the first to realize the necessity of the smaller arboretum or botanical garden in planting only "the best" varieties for display. This he has done to such an extent that his plantings on the Swarthmore campus are nationally recognized as containing only the best of the ornamentals. Trials of newer varieties are conducted but mediocre types are quickly discarded. This idea, well executed at Swarthmore, of planting only "the best" is one that will be duplicated in many places the country over, before long. When space and funds are limiting factors, institutions can do unusually well in emulating the Arthur Hoyt Scott Foundation at Swarthmore.

Featuring: Woody trees and shrubs — *Magnolia, Malus, Prunus, Rhododendrons, Syringa, Paeonia, Iris, Hemerocallis, Chrysanthemums, Narcissus.*
Species and vars.: 1000 species, 4000 varieties.
Ownership: Swarthmore College.
Endowment: Approx. $100,000. — *Operating Budget:* Approx. $5,000.
Admission free and open to public at all times.
Director: JOHN C. WISTER. — *Employees:* 1 plus staff.
Library: 300 vols.
Special events: Various meetings for garden clubs and similar organizations.
References: Bulletin of Swarthmore College, 6th month, 1940. — "The People's Garden," Saturday Evening Post, April 14, 1945. — "Arthur Hoyt Scott Horticultural Foundation at Swarthmore" by JOHN C. WISTER, Parks & Recreation 24, No. 2: 458-462, June 1941. — "The Arthur Hoyt Scott Foundation, a ten year history," Swarthmore College Bulletin 37, No. 5, June 1940.

72. *Westtown:* **Westtown School Arboretum**
Est. 1906 — 30 acres

Chief function: Education.

Recently on the campus of Westtown School an old tulip poplar was blown down which was approximately 225 years old. Amid such monarchs as this the teachers of botany have been trying to foster an arboretum development. Hampered by lack of funds for planting as well as maintenance, it was decided a few years ago to limit special efforts to one genus. This happy decision resulted in the genus *Abies* being selected and the collection of *Abies* here is probably the most complete of any in this country. When funds are limiting but energy is boundless, such a system of confining all the efforts to one small genus can well result in a marked contribution to our knowledge of plants. Westtown is to be commended for "carrying on" in this manner.

Featuring: Conifers, woody trees and shrubs — *Abies, Pinus, Picea.*
Species and vars.: 450 (without hort. vars.).
Ownership: Westtown School, Philadelphia. Yearly Meeting of Friends.
Operating budget: $350 to $500.
Admission free and open to public at all times.
Director: ALBERT L. BAILEY, Jr.
References: "Arboretum of Westtown" by ALBERT L. BAILEY, Jr., Parks & Recreation 26, No. 4: 181-183, Mar.-April 1943. — "The Arboretum at Westtown School" by ALBERT L. BAILEY, Jr., Forest Leaves 22, No. 2, April 1929.

— *SOUTH CAROLINA* —

73. *Charleston:* **Magnolia Gardens**

Est. 1840 — 25 acres

Chief function: Display gardens.

This estate, nearly 250 years old now has been known for its many splendid specimens of *Magnolia grandiflora* — from which it takes its name "Magnolia-on-the-Ashley" — and for its extensive plantings of *Camellias. Azalea indica* was first planted here in 1843 and since has thrived. Like several other southern gardens which are annually open to the public for long periods it is at its best when the camellias and azaleas are in bloom.

Featuring: Perennials, woody trees and shrubs — *Camellia japonica* and *Azalea indica.*
Species and vars.: 900 camellia, 40 azalea.
Ownership: C. NORWOOD HASTIE.
Operating budget: $25,000.00.
Admission: These gardens are open to the public January 1st to May 1st. — Admission $2.00.
Director: C. N. HASTIE, Jr. — *Employees:* 35.
Greenhouse: 1 Camellia house. — *Service greenhouse:* 1.
Private library: 200 vols.
Publication: Descriptive pamphlet (1947).

74. *Georgetown:* **Brookgreen Gardens**

Est. 1931 — 6,635 acres

Chief functions: To display a collection of native plants of the southeastern United States and to display a collection of American sculpture.

Another old southern plantation on the South Carolina coast close to the Atlantic Ocean, this differs radically from many gardens of the region by the extensive display of American sculpture, everywhere admirably displayed with an appropriate background of plants. Most of the plants grown at present have been collected by the horticulturist from the surrounding area, and because of his intensive search, new and interesting varieties have been discovered. The sculpture is limited to that suitable for displaying in a garden. There are now 256 works by 143 sculptors, all of which is displayed out of doors.

Featuring: Woody trees and shrubs.
Species and vars.: 350.
Ownership: Brookgreen Gardens Corporation.
Admission free and open to the public 9 a.m. to 5:30 p.m. every day except Mondays and Christmas Day.
Director: Corporation Officers, Board of Trustees and Resident Horticulturist, Mr. F. G. TARBOX, Jr. — *Employees:* 25-30. .
Library: 600 vols.
Publications: Descriptive pamphlets, catalogue of plants, catalogue of sculpture.

— *TEXAS* —

75. *Fort Worth:* **Fort Worth Botanic Garden**

Est. 1933 — 45 acres

Chief function: Education.

This garden is situated about two miles from the heart of the business district of Fort Worth, and comprises natural forest and rolling lawns as well as formal and

informal gardens. It was built almost entirely with relief labor under the Federal Relief Program. It is not a mere collection of plants, according to those in charge, but a series of gardens where every plant has been used to create some specific effect.

Included are The Water Garden, Wildflower and Arid Garden, Nature Trails, the Rose Unit, Test Gardens, Hothouse and the Garden Center. Here too is a special Council Ring where Boy Scouts and Girl Scouts have outdoor meetings. Fort Worth, often termed the "Garden City of the Southwest," is jealously proud of its Garden and its Garden Center and many public groups enter enthusiastically into the programs sponsored here. Aside from an excellent physical lay-out, the enthusiasm displayed in and about the garden is certainly worth noting regardless of the factors causing it.

Featuring: Cacti, evergreens, woody trees and shrubs, roses.
Species and vars.: 2,500.
Ownership: City of Fort Worth, Park Department.
Operating budget: $19,500.00.
Admission free and open to public at all times.
Director: Mrs. WILL F. LAKE. — *Employees:* 5.
Display greenhouse: 1.
Library: 500 vols.
Publication: Descriptive pamphlet.
Reference: "A Pioneer in Southwestern Garden History" by MARY DAGGETT LAKE, Parks & Recreation 26, No. 3: 117-122, Jan.-Feb. 1943.

— *VIRGINIA* —

76. *Boyce:* **The Blandy Experimental Farm Arboretum**

Est. 1927 — 100 acres

Chief functions: Experimental and research, educational laboratory for graduate students.

This arboretum is situated 65 miles northwest of Washington, D. C. It lies in a beautiful section of the Shenandoah Valley close to the Blue Ridge Mountains. For naturalistic landscape effects the families have been planted in hillside drifts. The laboratories are well equipped for cytological work and there is a good library in the fields of genetics, cytology and horticulture. Work is done specifically in cytology and genetics. Work one year, included the colchicine treatment of *Tropaeolum majus,* chromosome studies of many plants, inter-varietal, inter-specific and inter-generic crosses, cyto-taxonomic and genetic studies on the *Aristolochiaceae* and the *Solanaceae;* the embryogeny of *Crepis* with the aid of x-rays induced chromosome rearrangements, etc.

Featuring: Evergreens, woody trees and shrubs — conifers in general, *Pinus, Berberis, Phlox, Buddleia.*
Species and vars.: over 5,000.
Ownership: University of Virginia.
Admission free and open to public at all times.
Director: Dr. ORLAND E. WHITE, Prof. of Agricultural Biology.
Plant breeding!
Library: 2,000 vols.
Publications: Scientific technical papers in magazines.
Reference: "The Blandy Experimental Farm" by ORLAND E. WHITE, Parks & Recreation 25, No. 4: 143-147, Dec. 1941.

77. *Richmond:* **Maymont Park**

Est. 1890 (bequeathed to city 1925) — 94 acres

Chief function: Public park and museum.
Featuring: Perennials, evergreens, woody trees and shrubs.
Species and vars.: Several hundred.
Ownership: City of Richmond
Admission free and open to public from 10 a.m. to 7 p.m. every day.
Park Keeper: J. T. OLIVER. — *Employees:* 7.
Publication: Descriptive pamphlet (1942).

— *WASHINGTON* —

78. *Carson:* **Wind River Arboretum,** Pacific Northwest Forest and Range Experiment Station

Est. 1912 — 12 acres

Chief function: Forest research.
Featuring: Woody trees—*Coniferae.*

This arboretum is maintained by the Pacific Northwest Forest and Range Experiment Station, whose main office is in U. S. Court House, Main Street and Sixth Avenue, Portland, Oregon. The arboretum is at the Wind River Branch, 70 miles from Portland and 10 miles from Carson, Washington, which is its local post office address and nearest village.

Species and vars.: About 150.
Ownership: United States Forest Service.
Admission free and open to public at all times.
Field Officer in charge: ROBERT W. STEELE.
Publication: Descriptive pamphlet (1937).

79. *Seattle:* **University of Washington Arboretum**

Est. 1934 — 267 acres

Chief function: Educational, to grow as many different woody plants as the climate will permit.

One of the younger arboretums of the country, this is ideally situated in one of the best growing areas of North America where soil and climatic conditions frequently combine to aid vigorous growth. It is probable that a wider selection of plant materials can be grown here than at almost any other place in the United States north of the sub-tropical areas. A large propagation unit is in operation and rhododendrons are featured for more can be grown here than in any other part of the country. A very active and influential "Arboretum Foundation" has been formed of private individuals interested in the development of this plant collection. This is not necessarily an innovation but is functioning so well and vigorously that newly planned arboreta or botanical gardens could do well to study its methods of enlisting wide public support.

Featuring: Evergreens, woody trees and shrubs — *Rhododendron.*
Species and vars.: 3,214.
Ownership: University of Washington.
Operating budget: $38,000.00.
Admission free and open to public at all times.
Acting Director: B. O. MULLIGAN. — *Employees:* 14 plus.
Library: 280 vols.
Special events: Rhododendron show.
Publications: Descriptive pamphlet. — Arboretum bulletin (quarterly).
References: Arboretum Bulletin, Fall, 1946. — "Woodland Flowers and a Winding Glen," Christian Science Monitor Magazine 12, June 8, 1940.

— *WISCONSIN* —

80. *Madison:* **University of Wisconsin Arboretum**

Est. 1932 — 1140 acres

Chief functions: Ecological studies and outdoor laboratory for student instruction.
Featuring: Evergreens, woody trees and shrubs, prairie studies, woods, wild flowers.
Species and vars.: 700.
Admission free to public and open at all times.
Director: Prof. G. WM. LONGENECKER. — *Employees:* 12.
Publications: Descriptive pamphlet. — Journals.
Reference: "University of Wisconsin Arboretum" by G. WM. LONGENECKER, Parks & Recreation 25, No. 1: 25-31, Sept. 1941.

81. *Milwaukee:* **The Botanical Gardens, Charles B. Whitnall Park***

Est. 1929 — 450 acres

Chief functions: Educational, display gardens, test for hardiness.

* Hales Corners, R.R. 1, Box 16.

It is the purpose of this institution to keep accurate scientific information on all plant material that can be assembled and is hardy in this region, with the object in mind of improving the use and variety of plants grown. This is all governed by the Milwaukee County Park Commission which has gone on record as stating that "we are interested in having people know the better plants that are available and are also interested in having them learn how to use these plants correctly in the improvement of their own grounds." This commendable interest on the part of the Park Commission is very definitely expressed in the rolling plantings of the Botanical Gardens. Here formal beds and natural plantings have been combined to demonstrate good plants and good planning. Careful planning and intelligent care have been successfully combined here to make an outstanding botanical garden. Much has been accomplished to date, and considerable planting is still to be done in the future but as the people of Milwaukee County become more familiar with the restful plantings of this garden, people from farther distances will likewise be attracted to it.

Featuring: Perennials, annuals, evergreens, woody trees and shrubs.
Ownership: Milwaukee County Park Commission.
Operating budget: $49,000.00.
Admission free and open to public at all times.
Director: John Voight, Acting Supt.—*Employees:* 11-30.
Library: 304 vols.—*Herbarium* of many materials grown.
Special events: Educational exhibits, peony and iris shows, rose show, chrysanthemum show, lilacs, etc.
Reference: "The Botanical Garden in Charles B. Whitnall Park" by Alfred L. Boerner, Parks & Recreation 24, No. 7: 296-299, Mar. 1941.

—*CANADA*—

82. *Hamilton, Ontario:* Royal Botanical Gardens

Est. 1941 — 1600 acres

Chief functions: Research; education of students, members and public; recreation.

The city of Hamilton is situated on Burlington Bay, an arm of Lake Ontario, and the climate here is milder, possibly, than any other area in Canada. This botanical garden, another newcomer to an extending list, may well become prominent in the future as city and government financial aid becomes available. The governing officers are working hard to obtain increased support for a large tract of land already endowed with much natural beauty. It is hoped to make this botanical garden a cultural center for the area.

Featuring: Perennials, annuals, evergreens, woody trees and shrubs.
Ownership: Royal Botanical Gardens.
Operating budget: $43,000.
Admission free and open to public at all times.
Director: Dr. Norman W. Radforth.—*Employees:* 10.
Publication: Royal Botanical Gardens, Special Bulletin No. 1, Jan. 1947.
Reference: "Canada's Royal Botanical Gardens Show Progress" by A. T. Whitaker, Parks & Recreation 26, Nos. 1 and 2: 35-36, October 1942.

83. *Indian Head, Saskatchewan:* Dominion Forest Nursery Station

Est. 1942 — 5-7 acres

Chief functions: Test new types, improve present forms of trees suitable for planting in prairie farm shelterbelts. (See note under Forest Nursery Station, Saskatchewan, which applies to this nursery as well.)
Featuring: Evergreens, woody trees and shrubs—all genera and species likely to survive—at present 75 genera are represented.
Species and vars.: 280.
Ownership: Dominion of Canada, Department of Agriculture.
Admission free and open to public at all times.
Superintendent: John Walker.
Publication: "Planning and Planting Field Shelterbelts" by John Walker, Dominion of Canada, Department of Agriculture, Farmers Bull. 139, December 1946.

84. *Montreal:* **Montreal Botanical Garden***
Est. 1932 — 260 acres

Chief functions: Education and research.

This is one of North America's great display gardens, where scientific research and popular education go hand in hand. Closely co-operating with the Botanical Institute of the University of Montreal, though financially and administratively independent of it, this garden does much research work in special laboratories. The physical plant consisting of laboratories, lecture rooms, a library, greenhouses and all the other things of an institution of this caliber have been provided, and are of the best possible construction. This garden also serves as a center for many of the horticultural organizations with widely diversified activities, thus enabling staff members of the Garden to keep in touch with what is going on in horticultural circles outside their own.

The gardens are extensive and include an annual garden, a perennial garden, an alpine garden, an economic garden, a medicinal garden, a children's garden, an ideal community garden, test and trial gardens, water and bog gardens, over twenty greenhouses, a large nursery and ornamental plantings of several descriptions. Some are laid out formally, others are informal but everywhere much attention has been given to providing everything in which the people of this province might be interested.

The Montreal Botanical Garden has made special efforts to bring together as complete a collection as possible of the plants native to the province of Quebec. This has brought some new and interesting varieties into the foreground. Improved methods of cultivation may make them of more economic value than they have been heretofore. The extent of the facilities and activities of this garden can not be adequately portrayed in a few paragraphs. A visit to this extensive institution shows clearly that the people of this area are extremely interested in plants and are very fortunate in having been able to make possible such a modern horticultural and botanical center.

Featuring: The aim is to maintain representative collections of all types of plants.
Species and vars.: Over 10,000.
Ownership: City of Montreal.
Operating budget: $165,000.00.
Admission free and open to public from 9 a.m. to 5 p.m. in winter; to 10 p.m. in summer.
Curator: Henry Teuscher. — *Supt.:* Jacques Rousseau. — *Employees:* 95.
Service greenhouses: 23. — A large display greenhouse is under construction.
Plant breeding!
Library: 15,000 vols. — *Garden herbarium* of material grown. — *Herbarium* of the University of Montreal, kept at the Garden: approx. 500,000 sheets.
Special events: Exhibitions and lectures.
Publications: Descriptive pamphlet, Memoirs, Bulletins, Leaflets.
References: "Display Gardens for Public Instruction" by H. Teuscher, Parks & Recreation 24, No. 4: 173-178, Dec. 1940. — "The Montreal Botanical Garden" by H. Teuscher, May 1942.

85. *Morden, Manitoba:* **Experimental Station**
Est. 1924 — 43 acres

Chief functions: Education and research.

Probably not considered an arboretum in the strict sense of the word because only a small proportion of the grounds about the house are landscaped, nevertheless the long rows of nursery stock, much of which is grown under experimental conditions, has real value. The Superintendent has made a real contribution in testing and introducing new and better varieties of hardy ornamentals for this region.

The annual rainfall is about 19 inches and temperatures range from a high of 111° F. to a low of —40° F. making this area also one of Canada's difficult spots to grow a wide variety of trees and shrubs. This Experimental Station is interested in growing fruits as well as ornamentals and has issued much valuable information pertinent to this part of the Canadian prairie. Because of this work and interest in growing ornamentals, this Experiment Station is included in this directory.

Featuring: Perennials, evergreens, woody trees and shrubs.

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* 4101 Sherbrooke Street, East.

Species and vars.: Over 3,000.
Ownership: Dominion of Canada, Department of Agriculture.
Admission free and open to public at all times.
Superintendent: W. R. LESLIE. — *Employees:* 6-11.
Display greenhouses: 1. — *Service greenhouses:* 4.
Plant breeding! — Shrubs, vines and perennials.
Library: 260 vols.
Special events: Field days and seed distribution.
Publications: Interim reports, circulars and bulletins.

86. *Niagara Falls, Ontario:* **Niagara Parks Commission's School for Apprentice Gardeners**
Est. 1936 - - 150 acres

Chief function: A school for gardeners.
Species and vars.: Approx. 2,500.
Ownership: The Province of Ontario.
Operating budget: $30,000.00.
Admission free and open to public at all times.
Director: Mr. JOHN OAKES. — *Employees:* 6-24.
Library: 90 vols. — *Herbarium* of materials grown.
Special events: Annual fall exhibition of vegetables, berried shrubs.

87. *Ottawa:* **Dominion Arboretum and Botanic Garden***
Est. 1886 - - 65 acres

Chief functions: Exhibition of collection of trees, shrubs and herbaceous plants, research, recreation.

This arboretum and botanic garden not only serves its chief function as a national center for scientific research but also serves as a park for the city of Ottawa as well. Herbaceous borders and flowering plants have been added to the arboretum planting in recent years, to increase the popular interest in the garden. Located adjacent to the Government Experimental Farm on the outskirts of Ottawa there are splendid possibilities for reciprocal advantages to both institutions from this close association.
Featuring: Woody trees and shrubs — *Caragana, Buddleia.*
Species and vars.: 1500-2000.
Ownership: Dominion of Canada, Department of Agriculture.
Operating budget: Approx. $40,000.
Admission free and open to public at all times.
Officer-in-charge: Dr. H. A. SENN, Senior Botanist.
Service greenhouses: 4 main houses with 11 sections.
Library: 20,000 vols.
Special events: Tours, exhibits.
References: "The Dominion Arboretum at Ottawa" by HAROLD A. SENN, Parks & Recreation 24, No. 11: 509-513, July 1941. — "The Dominion Arboretum", Parks & Recreation 27, No. 2: 80-84, March-Apr. 1944.

88. *Sutherland, Saskatchewan:* **Forest Nursery Station**
400 acres

Chief functions: Growing and distributing shrubs and trees for shelterbelt planting.

In this area, with winter temperatures reaching —40° F. or lower and with an annual rainfall of about 15 inches, the growth of woody plants is somewhat of a problem. Only the most rugged survive. This nursery as well as the one at Indian Head, are listed in this directory because they are continually seeking the most hardy woody plants. Only a few, comparatively, survive and these are used by the farmers in the surrounding territory in shelterbelt planting in a definite attempt to raise the productivity of the land.
Featuring: Perennials, evergreens, woody trees and shrubs — *Prunus* hybrids.
Ownership: Dominion of Canada, Department of Agriculture.
Admission free and open to public at all times.

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* Address: Central Experimental Farm.

Director: W. L. KERR.
Plant breeding!

89. *Vancouver, British Columbia:* **University of British Columbia Botanical Gardens**
Est. 1912 — 5 acres

Chief functions: Education, as well as "to assemble a representative collection of plants from all parts of the Province, and to grow sets of 'critical' genera for study and research; to determine accurately their species and apply their valid names". Actually the educational functions of this garden are now more important. There is an exotic garden, a medicinal garden, a rock garden and an aquatic garden as well as a native garden and a native arboretum. These gardens feature plants native to British Columbia.
Featuring: Perennials, annuals, evergreens, woody trees and shrubs — Canadian and United States trees.
Species and vars.: Approx. 1000.
Ownership: Department of Botany, University of British Columbia.
Admission free and open to public at all times.
Director: Prof. JOHN DAVIDSON. — *Employees:* 2.
Publication: "The University of British Columbia Botanical Gardens" by JOHN DAVIDSON (1938).

— *CUBA* —

90. *Cienfuegos:* **Atkins Garden and Research Laboratory***, Harvard University
Est. 1900 — 221 acres

Chief functions: Acquaint students of botany with tropical flora. Experimentation in economic crops.
An interesting and extensive collection of tropical plants, trees, shrubs and vines, formerly owned by EDWIN F. ATKINS. The Soledad Sugar Company still owned and operated by the Atkins family owns the land surrounding this garden and operates this land as a sugar plantation. This is one of the few such tropical gardens in tropical America and the only one not government supported. It is interesting to note that in this garden the *Cactaceae* are represented by 47 genera and 260 species while there are over 260 species of true palms.
Featuring: Succulents, woody trees and shrubs — *Ficus, Agave, Tabebuia, Euphorbia, Acacia, Bauhinia, Cassia, Erythrina, Aloe, Eugenia, Phoenix, Sabal, Pandanus, Ixora.*
Species and vars.: Over 2,000.
Ownership: Harvard University.
Admissions free and open to public at all times.
Director: ARTHUR G. KEVORKIAN. — *Employees:* 16.
Service greenhouse: 1.
Plant breeding!
Library: 610 vols.
References: "The Atkins Institution of the Arnold Arboretum" by E. D. MERRILL, Bulletin of Popular Information, Series 4, 8, No. 13: 65-74, 1940. — "The Atkins Institution at Soledad, Cuba" by E. D. MERRILL, Parks & Recreation 24, No. 6: 246-251, Feb. 1941.

* Apartado 251, Soledad, Cienfuegos, Cuba.

A Portfolio of Prints and Photographs of Botanical Gardens and Arboretums Old and Modern — American and Foreign illustrating their Development and Present Scope

PLATE 27. ENCLOSED GARDEN (*ca.* 1600), with chess-board arrangement of raised square beds, showing a considerable variety in the flower beds. After an engraving by P. FIRENS, based on a Brussels tapestry of 1601 executed in honour of the Virgin of Montaigne (*cf.* CRISP 1:131 and 225, also reprod. in CORPECHOT'S "Parcs et Jardins de France", 1937, p. 35).

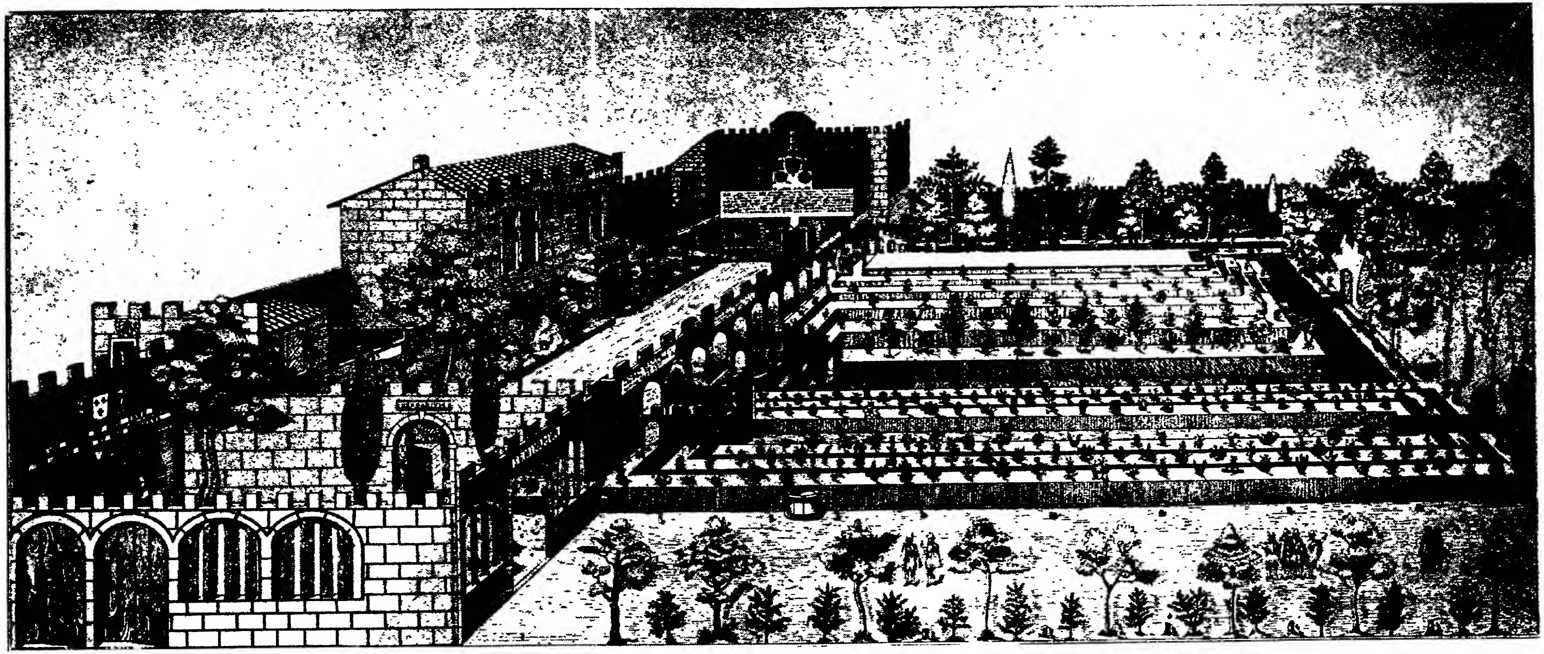


Plate 28. — The Botanical Garden of the University of Montpellier in 1596, after an etching attributed to Richer de Belleval, who established the garden that year. As most gardens in those times it belonged to the University's famous Faculty of Medicine (*cf.* Martins 1854. Le Jardin des Plantes de Montpellier).—University Botanical Gardens had been established since circa 1543 (Pisa; 1545:Padova; 1568:Bologna; 1577:Leyden).

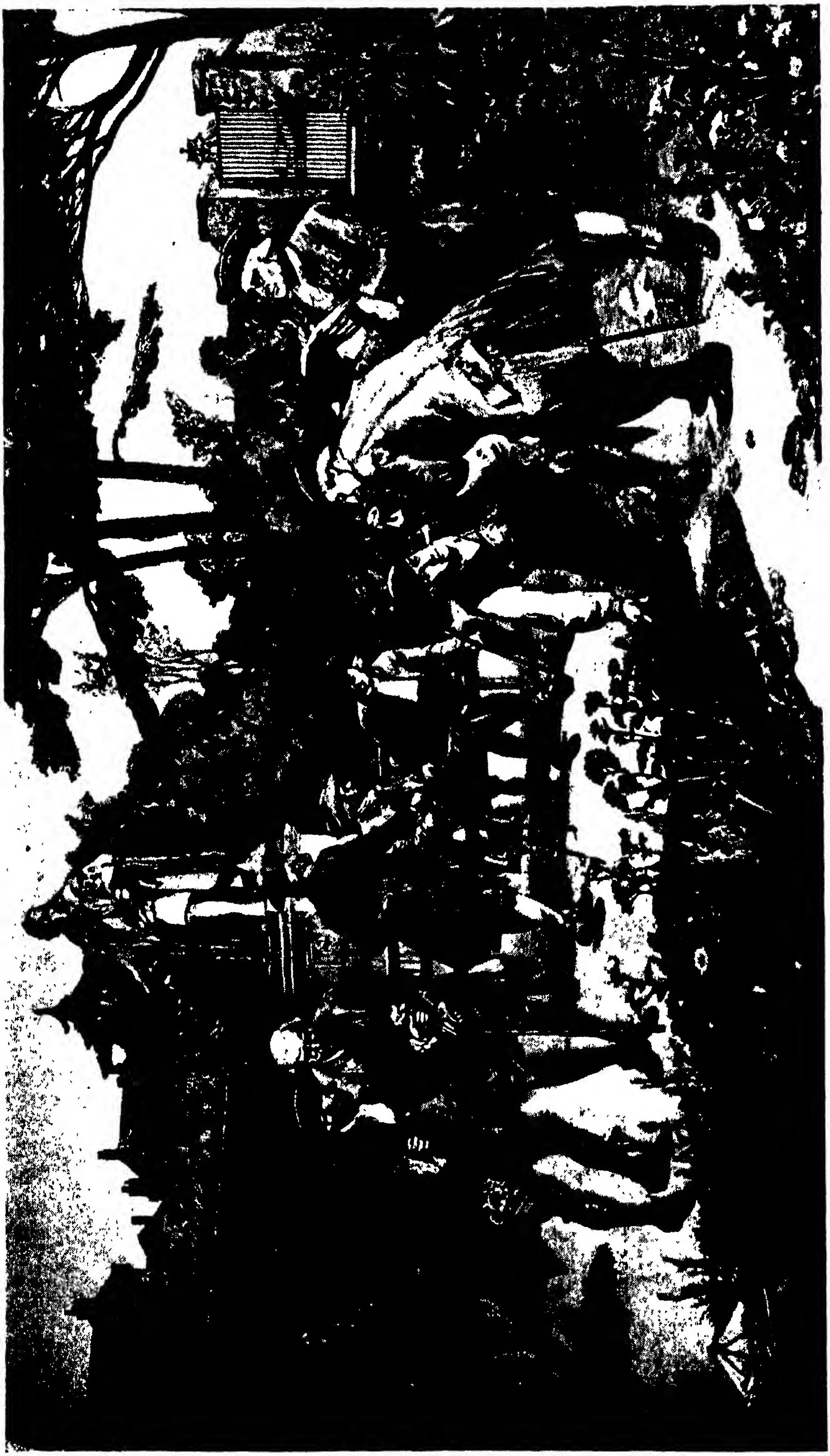
* * * * *

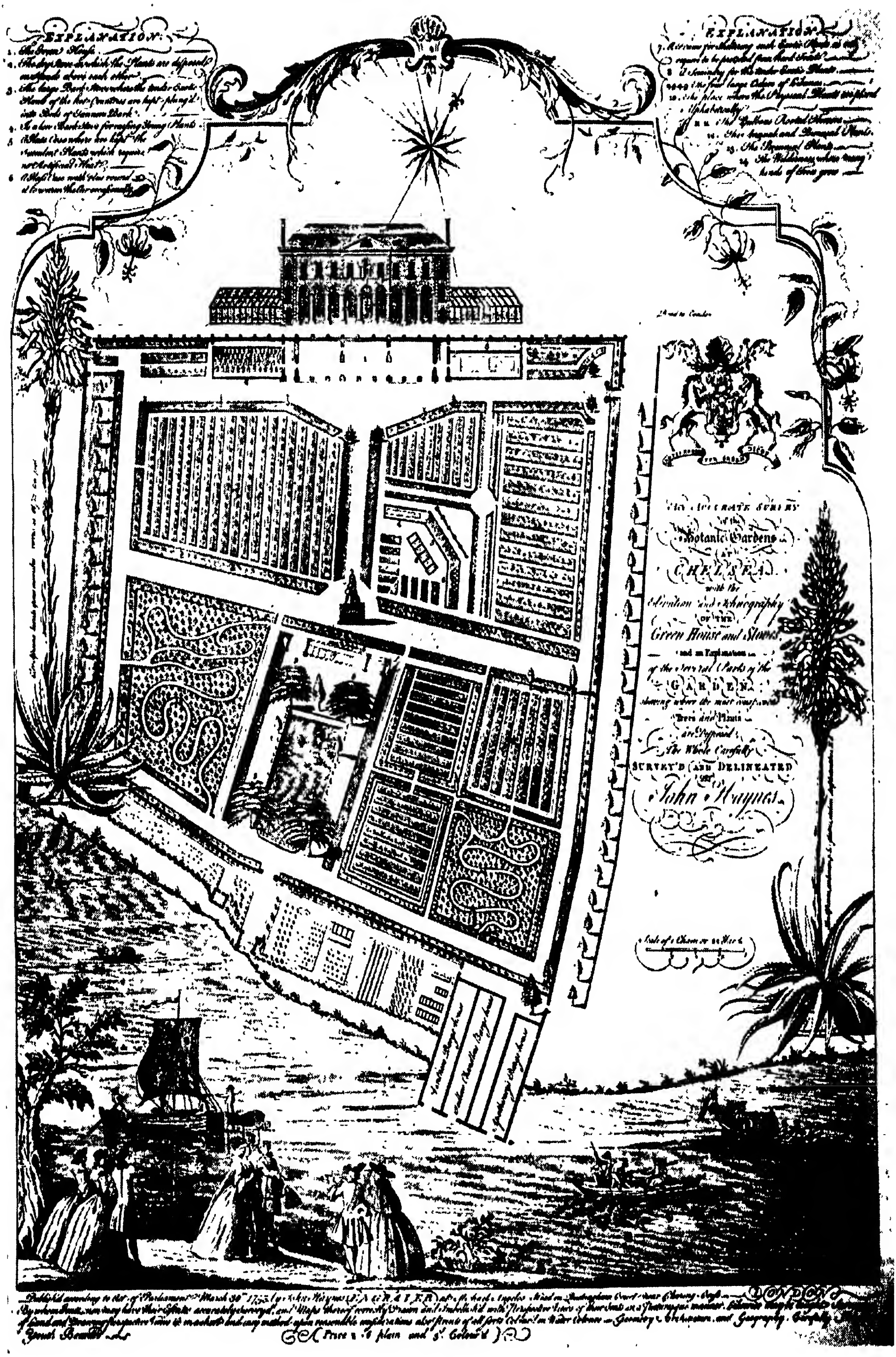
There exists an extensive literature on early gardens: most useful are: Crisp's "Mediaeval Gardens" (2 vols.; London, 1924), Gothein's "History of Garden Art" (2 vols.; London, 1928, originally published in German), Gunther's "Early British Botanists" (Oxford, 1922), Jessen's "Botanik der Gegenwart und Vorzeit" (Leipzig, 1864), Lockwood's "Gardens of Colony and State" (2 vols.; Scribner's 1931), Rohde's "The Story of the Garden" (London, 1933), Schultes' "Gesch. der Botanik, nebst einer Geschichte der Botanischen Garten" (Wien, 1817), Tabor's "Old Fashioned Gardening" (New York, 1913, a good book on Colonial Gardens), and Wright's "Story of Gardening" (New York, 1934).

A more extensive bibliography of the older works will be found in Pritzel's "Thesaurus", ed. 2. For recent works one may consult the catalogues of the Royal (London) and Massachusetts Horticultural Societies.

PLATE *29a.* — A VIEW IN THE FAMOUS BOTANICAL GARDEN, LE JARDIN DES PLANTES, OF PARIS (*ca.* 1850). This garden and the many distinguished members of its staff, as ADANSON, the DE JUSSIEUS, LAMARCK, and TOURNEFORT, played a great part in the development of botany and the introduction of new plants. The famous 'Orangerie' is shown at the right. Several historical accounts have been published about the garden (*e.g.* CAP's "Le Muséum d'Histoire Naturelle", Paris, 1854), and more recently DENISE has given us a unique "Bibliographie du Jardin des Plantes" (Paris, 1903).

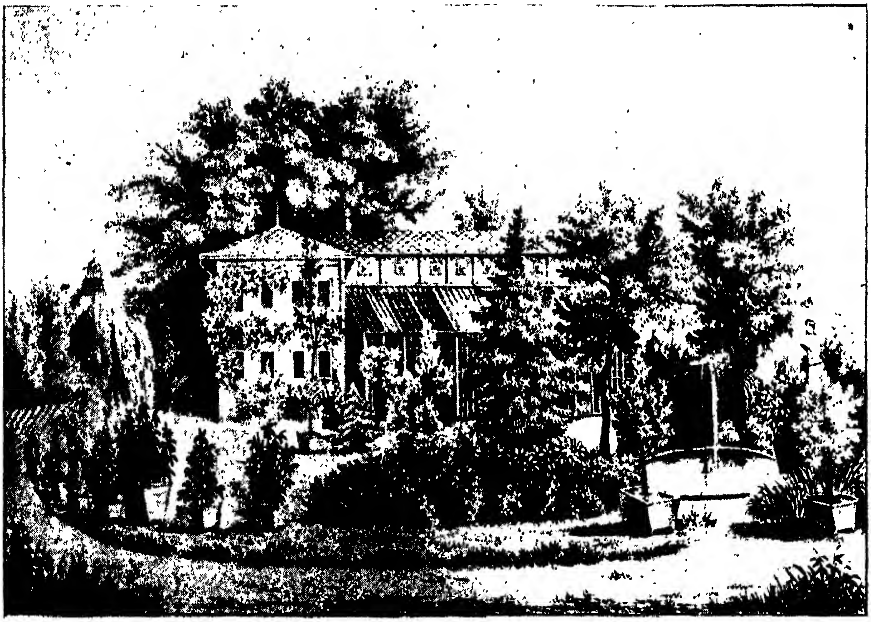
PLATE *29b.* — The Russian aristocracy was much interested in horticulture and there were an unusual number of private, botanic gardens in Russia at the middle of the last century. Our lithograph shows one of THE GREENHOUSES AT THE ST. PETERSBURG BOTANICAL GARDEN (*ca.* 1857, at that time under the direction of the famous Swiss botanist and horticulturist, ED. REGEL, founder of the *Gartenflora*). For some of the numerous publications about this garden *vide* ASMOUS's "Fontes Bibl. Bot. Rossiae" (CHRON. BOT., vol 11).





Plates 30 and 31 show the classic English Apothecaries Garden at Chelsea, London, established about 1673 (*cf.* Drewitt's "Romance of the . . . Garden at Chelsea", ed. 3, Cambr.U.P., 1928) which exercised much influence in England before the development of the Kew Gardens. The painting, reproduced at the left, by the courtesy of John Gilmour and Sir William J. Collins, was made in 1750, the map above in 1753 (under the direction of Isaac Rand, demonstrator of the gardens; very probably the gentleman showing the garden's treasures to the apothecaries).

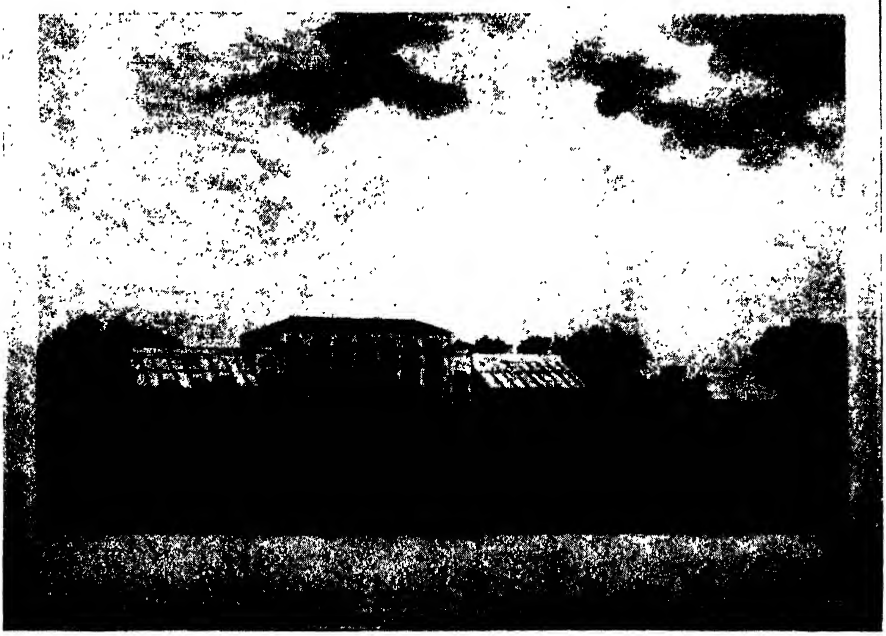

SITUATIONSPLAN
des
Botanischen Gartens
in Zürich
1853.
West
Nord
Süd
Ost
100'
200
300'

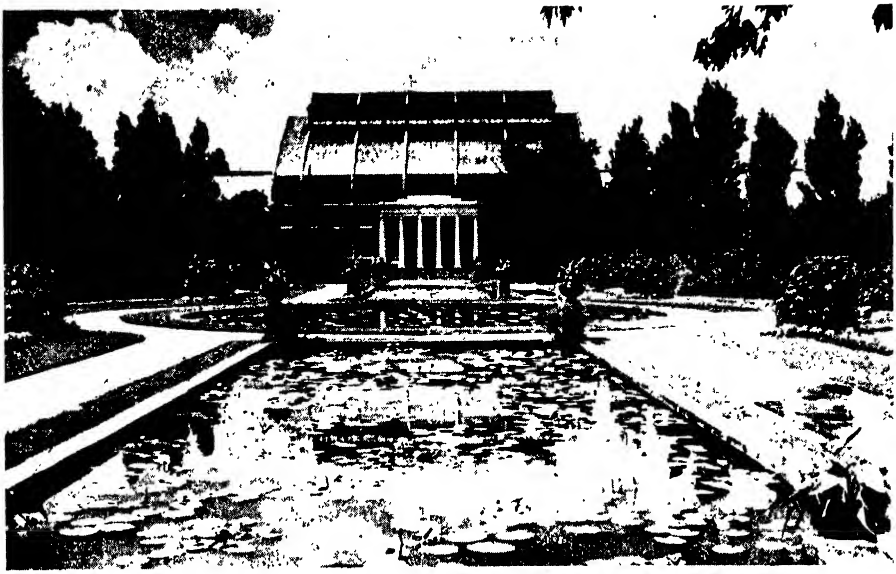


PLATES 32 (*left*) AND 33*a* (*above*) SHOW THE ZURICH GARDEN, a typical, large, continental botanical garden at the middle of the past century, when botanical gardens began developing into botanical research institutions.

PLATE 33*b*. There exist more books about early Italian gardens than about almost any other type of gardens. There were an amazing number of botanical gardens, pleasure gardens, and medicinal plant gardens in the Italian states in the Renaissance. Our plate shows as 'typical' a garden of that time as one may select from the numerous, fine prints available, the well preserved BOBOLI GARDEN, FLORENCE.

PLATES 34 *a and b* SHOW TWO FAMOUS, EARLY NORTH AMERICAN BOTANICAL GARDENS, BARTRAM'S GARDEN (*supra*, after a recent painting by SIMON GRECO, an interesting reconstruction showing BARTRAM and DE CRÈVE COEUR, reproduced by courtesy of the Continental Distilling Corp. of Philadelphia) AT PHILADELPHIA, and the ELGIN GARDEN IN NEW YORK. BARTRAM's garden and the house which he built 'with his own hands' do still exist today. The Elgin garden has been discontinued a long time ago; it was located approximately at the present site of the Rockefeller Center near Fifth Avenue. There exist numerous papers on these early gardens, but a good book on the early botanical gardens of North America has still to be written.





— Two Famous Contemporary Gardens —

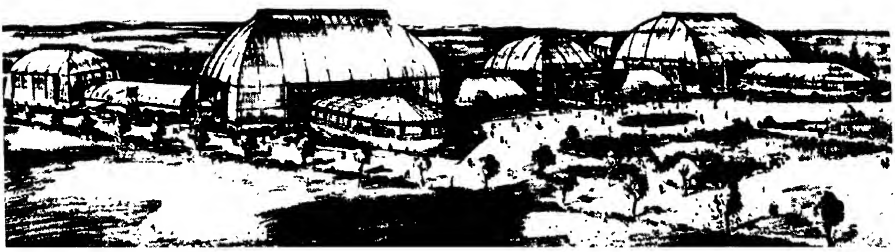
Plate 35*a*. — The lily pools and conservatory of the Missouri Botanical Garden, St. Louis, Mo. (*cf.* p. 437). Many new water lilies have been originated here.

Plate 35*b* shows one of the main conservatories of the present New York Botanical Garden to which it is planned to add several new exhibition houses (*cf.* pp. 442-444).

Plate 36.— An aerial view of the Arnold Arboretum at Jamaica Plain, Mass. (*cf.* p. 431 and especially also the map on p. 430). No horticultural institution in the U.S.A. has played a greater part in the development of American horticulture. Such well-known plants as the Japanese Barberry and the Beautybush were first introduced from abroad by the Arboretum. Its herbarium and library are surpassed by only very few institutions.— A good account of the gardens has been given by E. H. Wilson ("America's Greatest Garden", Boston, 1925). Much additional information will be found in *Garden and Forest, The Bulletin of Popular Information of the Arnold Arboretum* and *Arnoldia.*

PLATE 37*a*.— CHARLES SPRAGUE SARGENT (1841-1927), *right*, and E. H. WILSON ('Chinese Wilson', 1876-1930) *left*, who were chiefly responsible for the development of the Arnold Arboretum. SARGENT was its director from 1872 till 1927 and WILSON, known for his Chinese explorations, its keeper from 1927 till 1930. All concerned with American dendrology and arboretums owe so much to these two men that it seemed only fitting to include their portraits in this booklet. (In the background: *Prunus subhirtella*).

PLATE 37*b*.— THE PROJECTED RANGE OF GREENHOUSES OF THE MONTREAL BOTANICAL GARDENS (*cf.* p. 456) at Montreal, Canada. When completed this will be the largest group of botanical conservatories in North America. At present, already over twenty conservatories and service greenhouses are filled with plants for display in this wonderful collection of living plants. Mr. TEUSCHER, the Curator, has given an account of the ideas underlying his ambitious project in an interesting article listed in the bibliography (p. 481).



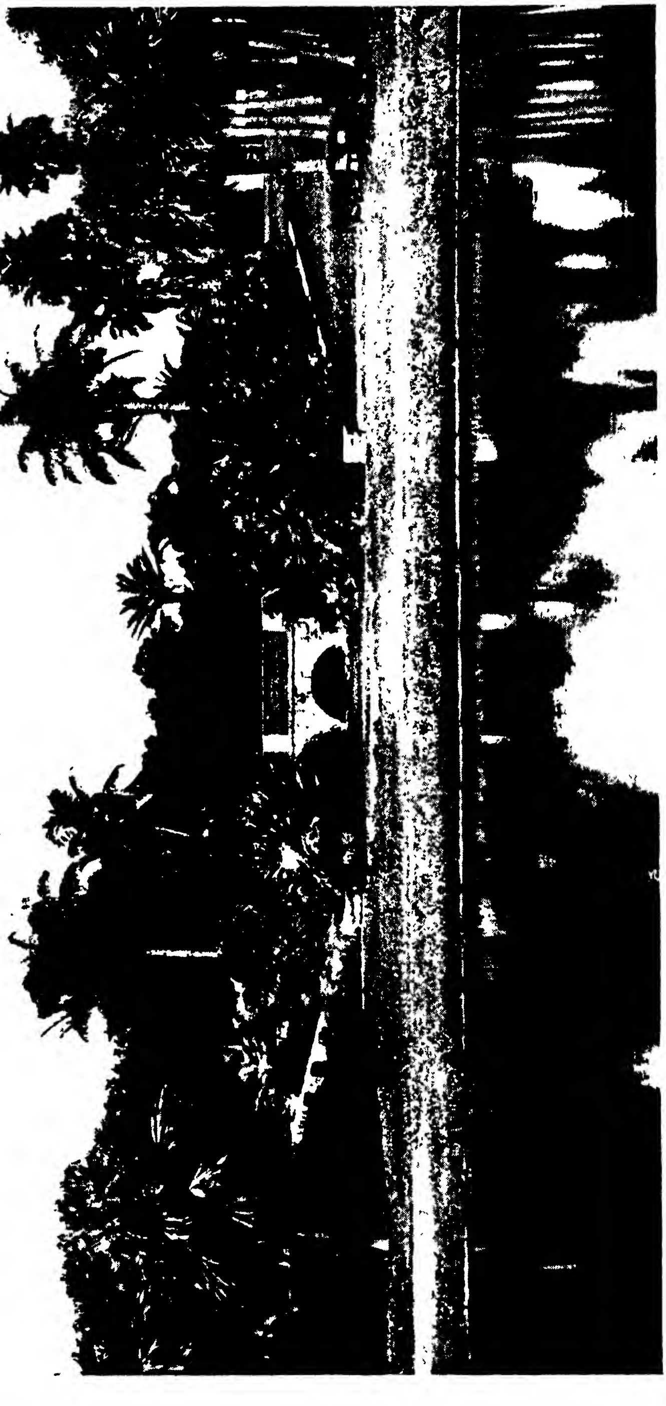


PLATE 38. — NORTH AMERICA'S ONLY TRULY TROPICAL BOTANICAL GARDEN, THE FAIRCHILD TROPICAL GARDEN AT COCONUT GROVE, NEAR MIAMI, FLORIDA (*cf.* p. 425). Our photograph shows the Bailey Palmetum, where 260 species of palms and cycads are already being grown in this prominent Arboretum of the deep South. Much of interest about the garden and its plants will be found in DAVID FAIRCHILD'S latest book, "The World grows round my Door" (New York, 1947).

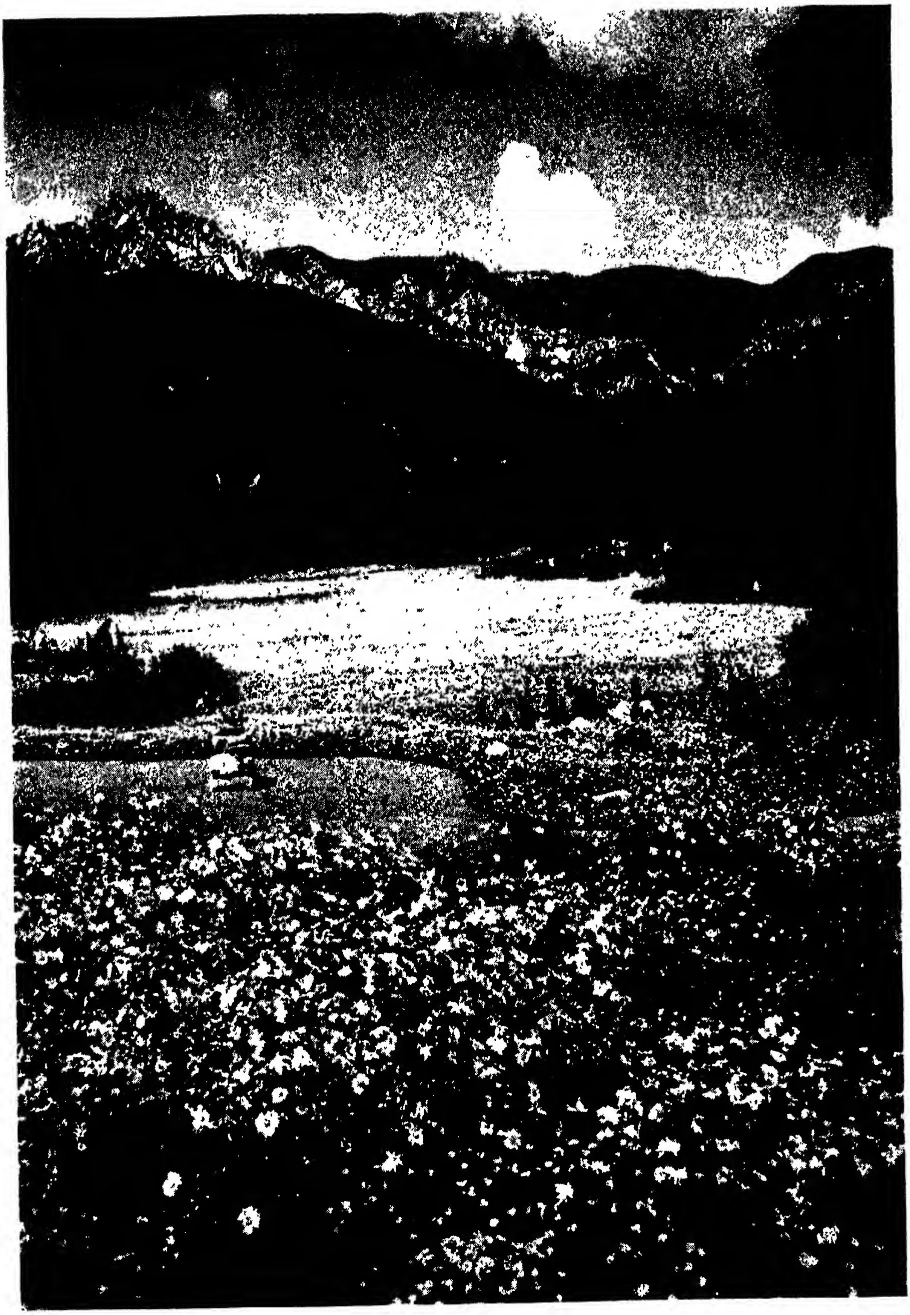


PLATE 39.—THE SANTA BARBARA BOTANIC GARDEN, SANTA BARBARA, CALIF., 85 miles North of Los Angeles (*cf.* p. 423). This lovely California garden is strikingly different from the Florida garden shown in the previous plate. It features the wild flowers, trees and shrubs native to this area of California.

Plate 40.— A part of the Cactus garden of the Boyce Thompson Southwestern Arboretum at Superior, Arizona, where the annual rainfall is only about 10-15 inches a year. The Boojamtree (*Idria columnaris*) and Organpipe cactus are shown in the foreground, and the rugged treeless terrain of this dry rocky country in the background (*cf.* p. 420).

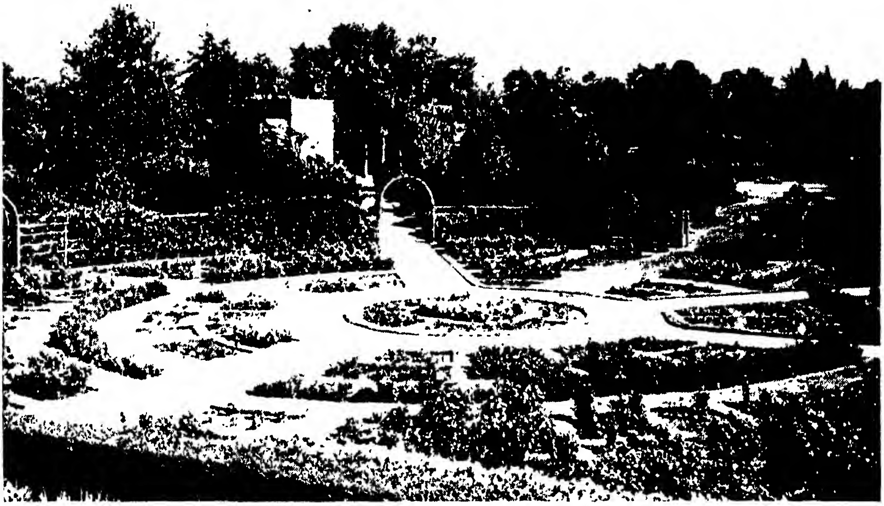


PLATE 41*a*.— MISSOURI BOTANICAL GARDEN'S rose garden, one of several display gardens at this great midwestern institution (*cf.* p. 437).

PLATE 41*b*.— THE FAMOUS HEDGE DEMONSTRATION GARDEN OF THE MORTON ARBORETUM AT LISLE, ILLINOIS, where a collection of over 150 clipped hedges, the most extensive collection of its kind in North America, is featured (*cf.* p. 428).

PLATE 42*a*. —THE BEAUTIFUL WALL GARDEN IN THE MORRIS ARBORETUM, CHESTNUT HILL, PHILADELPHIA, PA., one of the older estates in Philadelphia, now an important arboretum in its own right and functioning as a part of the University of Pennsylvania (*cf.* p. 450).

PLATE 42*b*. THE OLD HARVARD UNIVERSITY BOTANICAL GARDEN, WITH THE GRAY HERBARIUM, AT CAMBRIDGE, MASS. Our photograph, a nostalgic picture, taken by Dr. REHDER in 1903, before the glass houses were discontinued and the present herbarium built, shows the typical university botanical garden as it existed all over the world a generation ago: professor's residence, herbarium and laboratory, conservatory, greenhouses, and the plants grown in neat rows according to the 'natural system'.

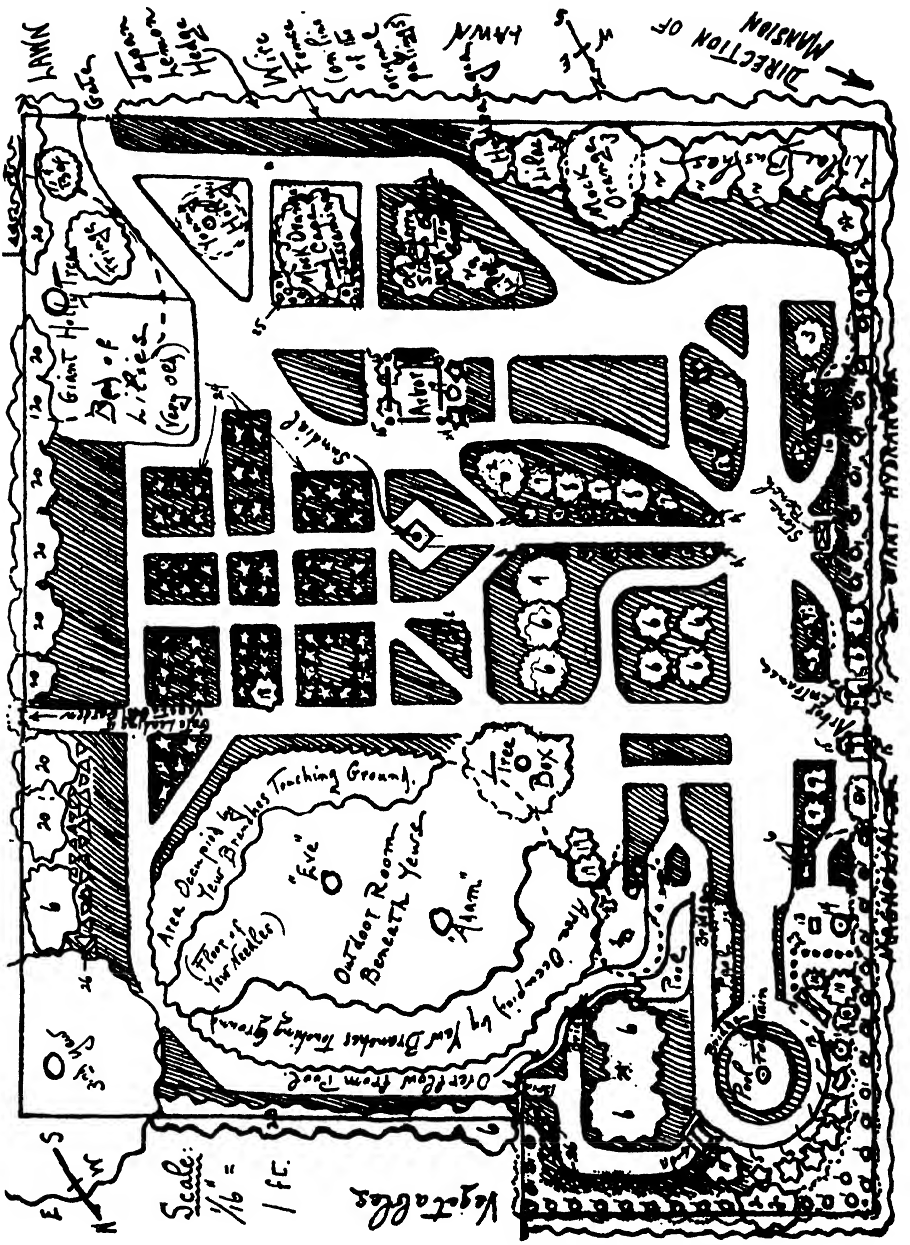
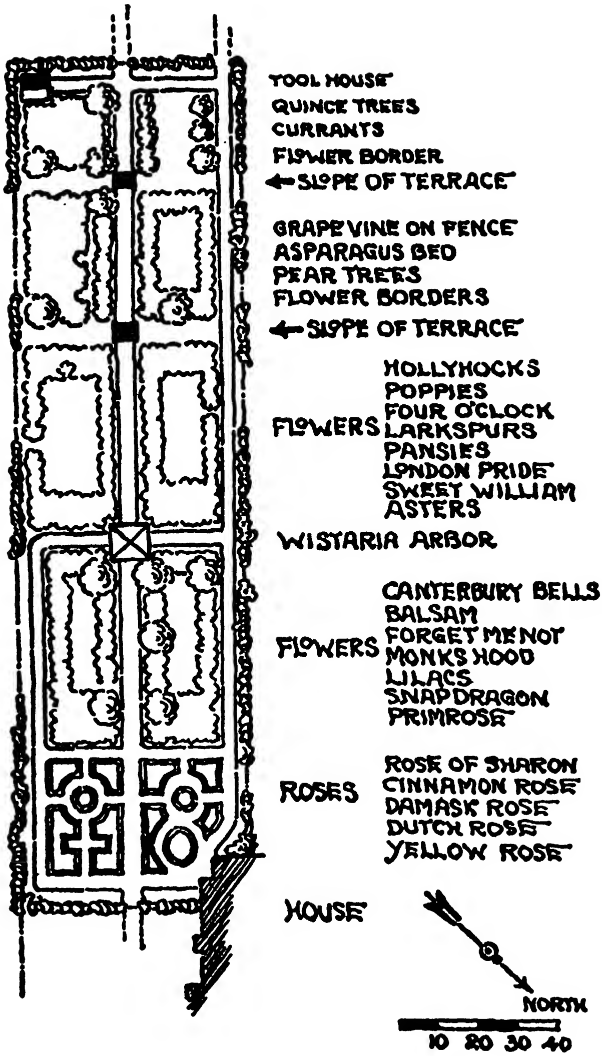


PLATE 43. — It is not too easy to find *critical* plans and planting lists of early American gardens. The above garden, interesting for its great variety of planting material (though not a botanical garden in the strict sense of the word), was laid out by HELEN SKIPWITH COLES in 1804 at Tallwood, Virginia, and has recently been reconstructed (*cf.* LOCKWOOD'S Gardens of Colony and State 2:109). The shaded areas are flower beds, separated by grass walks. Solid lines enclose areas covered by low branching shrubs, vines, etc. Dotted lines enclose areas covered by spread of tall shrubs and trees. Numbers indicate the following: 1, Crape-Myrtle; 2, Lilac; 3, Mock Orange; 4, Box; 5, *Pyrus japonica;* 6, Old, original rose bushes of immense size; 7, *Abelia;* 8, *Buddleia;* 9, Original peonies of great size; 10, *Rhododendron;* 11, Japanese ornamental grass; 12, *Mimosa,* overhanging pool; 13, Hydrant, with shell-shaped stone covering; 14, Norway Maple; 15, Climbing roses; 16, Long arched support for Mock Orange and climbing roses forming tunnel; 17, *Kerria;* 18, *Calycanthus* 'bush of great age and unusual size; 19, Aspen; 20, *Clematis,* trumpet vine, and climbing honeysuckle intermixed; 21, Bush honeysuckle; 22, *Exocordia,* or Pearl Bush; 23, *Azalea nudiflora;* 24, Tea and hybrid roses (some original and some new); 25, Native orchids; 26, Hollyhocks.



Reconstruction of a Colonial New England Garden ('a characteristic long narrow garden having a *Wisteria* arbor, in other respects having no relation to the house') with a considerable variety of plants, showing the carefree layout as far as classic precedent is concerned (after A. A. Shurcliff in "Colonial Gardens, the Landscape Architecture of George Washington's Time", 1932).

PROPOSED ARBORETUMS OR BOTANICAL GARDENS

Many of these arboretums or botanical gardens are already established or will be established shortly but have been able to do little planting up to this time. The list clearly shows a widespread interest in arboretums and botanical gardens, an interest which should be fostered in every way possible.

California:—
California Arboretum (*Arcadia*)
Lucky Baldwin Ranch Arboretum (*Oakland*)

Colorado:—
Denver Arboretum (*Denver*)

Georgia:—
Georgia Botanic Garden (*Five Points*) (8¼ mi. from Atlanta)

Illinois:—
Abraham Lincoln Memorial Garden (*Springfield*)

Kansas:—
Winter Veterans Administration Hospital Arboretum (*Topeka*)

Kentucky:—
Bernheim Forest Arboretum (*Clermont*)

Maryland:—
Goucher College Arboretum (*Towson*)

Michigan:—
Beal Botanical Garden, Mich. State College of Agric. (*East Lansing*)

Minnesota: —
Mayo Arboretum (*Rochester*)

Nebraska:—
Memorial Park (Arboretum) (*Omaha*—Dodge St. & Happy Hollow Blvd.)

New York:—
Bayard Cutting Arboretum (*Oakdale, L. I.*) (Visitors by permission only)

North Dakota:—
International Peace Garden (*Rolla*)

Ohio:—
Antioch College - Glen Helen (*Yellow Springs*)
Cleveland Street Tree Demonstration Arboretum (*Brecksville*)
Adell Durbin Arboretum (*Stow*)
Trumbull Arboretum (*Warren*)

Tennessee:—
The Sewanee Ravine Garden, University of the South (*Sewanee*)
Memphis Park (*Memphis*)

Texas:—
Arboretum and Botanical Garden (*Houston*)
Botanical Garden for Lake Jackson (*Lake Jackson*)

Utah:—
Edgewood Hall (*Providence*)

Virginia:—
Virginia Polytechnic Institute Arboretum (*Blacksburg*)

West Virginia:—
Oglebay Park Arboretum (*Wheeling*)

THE MONTGOMERY PLACE (*circa* 1840) ON THE HUDSON, NEAR TARRYTOWN, N. Y., the famous residence and gardens established by General MONTGOMERY, the hero of Quebec, and developed by his relatives, the LIVINGSTONS. At a time when there were few botanical gardens and hardly an arboretum in the U.S.A. this estate exercised on a small scale an influence which may be compared with that of the Prince VON PÜCKLER's Park at Muskau in Silezia. Writes the immortal DOWNING in the early editions (1875 etc.) of his 'Treatise . . . of Landscape Gardening': "The lover of the expressive in nature, or the beautiful in art, will find here innumerable subjects for his study. The natural scenery in many portions approaches the character of grandeur, and the foreground of rich woods and lawns, stretching out on all sides of the mountain, completes a home landscape of dignified and elegant seclusion, rarely surpassed in any country. Among the fine features of this estate are the wilderness, a thickly wooded and highly picturesque valley, filled with the richest growth of trees . . . This valley is musical with the sound of waterfalls, of which there are several fine ones in the bold impetuous stream which finds its course through the lower part of the wilderness. Near the further end of the valley is a beautiful lake, half of which lies cool and dark under the shadow of tall trees, while the other half gleams in the open sunlight. In a part of the lawn, near the house, yet so surrounded by a dark setting of trees and shrubs as to form a rich picture by itself, is one of the most perfect flower gardens in the country . . . A large conservatory, an exotic garden, an arboretum, etc., are among the features of interest".

There were numerous establishments of a similar nature along the Hudson in those years, as the well-known Philipse Manor of which ANN ELIZA (SCHUYLER) BLEECKER wrote:

"The eastern banks are crowned with rural seats,
And Nature's work the hand of Art completes.
Here Philipse' villa, where Pomona joins
At once the product of a hundred climes.
Here, tinged by Flora, Asian flowers unfold
Their burnished leaves of vegetable gold.
When snows descend, and clouds tumultuous fly,
Through the blue medium of the crystalline sky
Beneath his painted mimic Heaven he roves
Amidst the glass-encircled citron groves;
The grape and luscious fig his taste invite,
Hesperian apples glow upon his sight,
And sweet auriculas their bells display,
And Philipse finds, in January, May."

ARBORETUMS OR BOTANICAL GARDENS WHICH HAVE BEEN DISCONTINUED*

Arizona:—
Desert Botanic Laboratory (*Tucson*)

California:—
Stephen Vavra Botanical Collection (*West Los Angeles*)
Pacific Botanical Garden at Leland Stanford Univ. (*Palo Alto*)
Kate Sessions Botanical Garden (*San Diego*)
Carnegie Inst. of Washington, Mission Canyon (*Santa Barbara*)

Connecticut:—
Pinetum of George P. Brett (*Fairfield*)
Hartford Arboretum (*Hartford*)

Iowa:—
Grinnell College Arboretum (*Grinnell*)

Louisiana:—
Tulane University Arboretum (*New Orleans*) (never materialized)

Maine:
Arboretum of Knox Academy of Arts and Sciences (*Thomaston*)

Maryland:—
Johns Hopkins University Arboretum (*Baltimore*)
University of Maryland Arboretum (*College Park*)

Michigan:—
Leila Arboretum (*Battle Creek*)
Hemingway Evergreen Arboretum (*Charlevoix*)

Minnesota:—
Underwood Arboretum (*Lake City*)

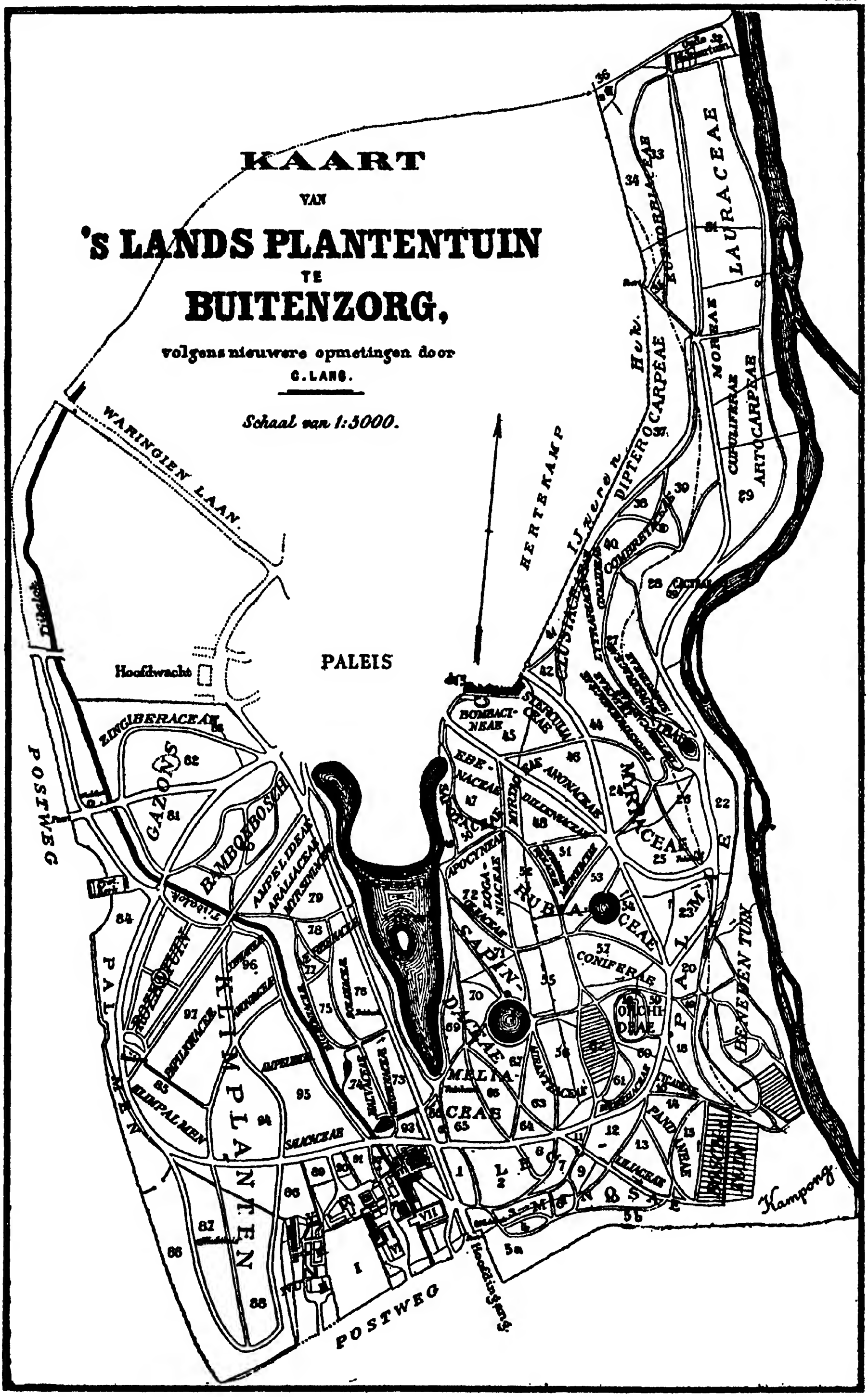
New York:
Buffalo City Hospital Botanic Garden (*Buffalo*)
Hamilton Arboretum (*Irvington*)
Hodenpyle Arboretum (*Locust Valley, Long Island*)

Tennessee:—
A. F. Sanford Arboretum (*Knoxville*)

Texas:—
Texas Botanical Garden at Univ. of Texas (*Austin*)
Hegle-Ness Arboretum (*College Station*)

Wisconsin:—
Ripon College Botanic Garden (*Ripon*)

* These were mostly still listed as active in Mr. PELE's report of 1939.

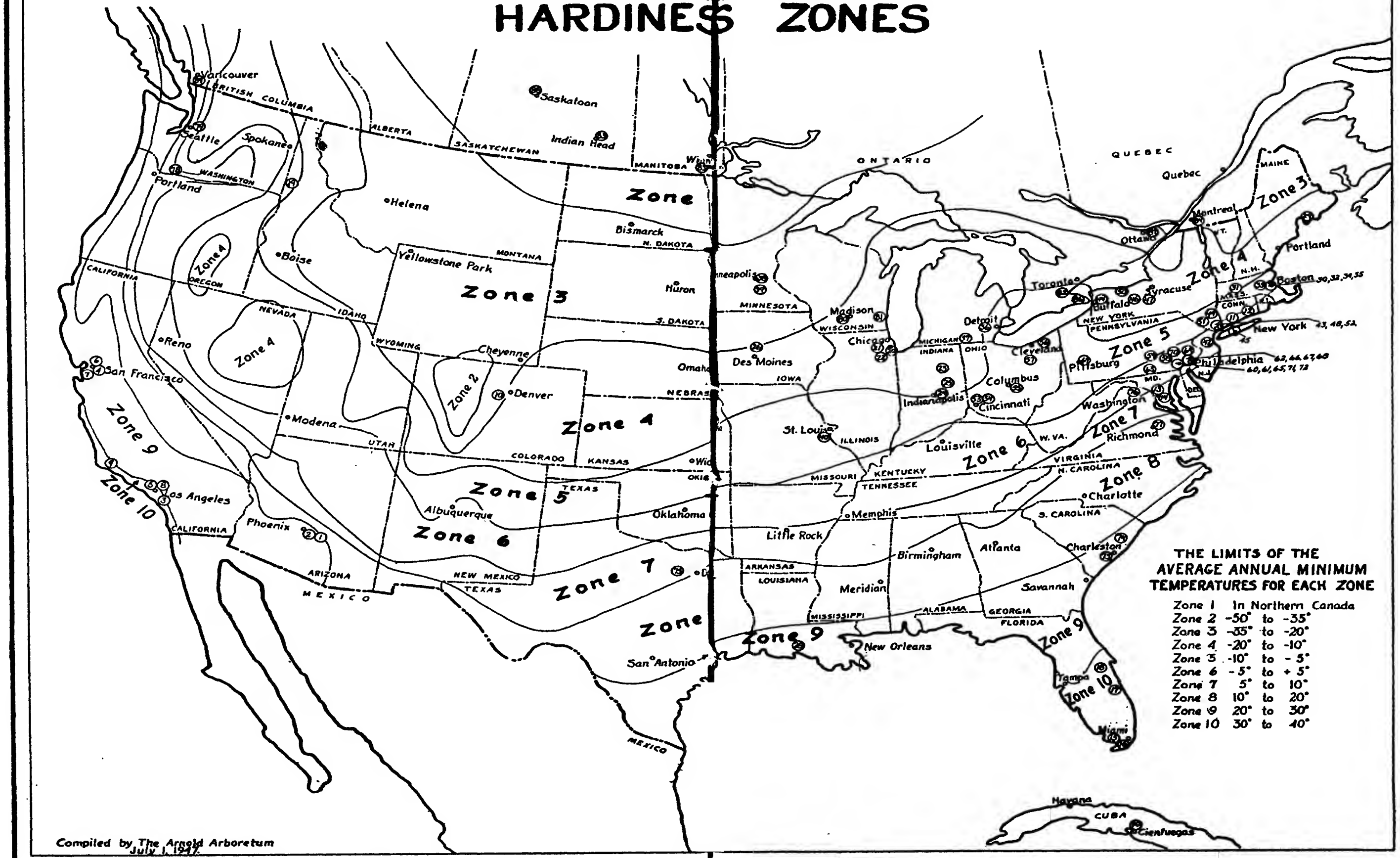


ONE OF THE OLDEST AND LARGEST TROPICAL BOTANICAL GARDENS IN THE WORLD, 's LANDS PLANTENTUIN, THE GOVT. BOTANIC GARDENS AT BUITENZORG, JAVA (circa 1900). Many North American and European botanists received their first introduction to tropical plant life in its rich and varied quarters. More detailed information will be found in HONIG and VERDOORN's recent "Science and Scientists in the Netherlands Indies" (New York, 1945).

ALPHABETICAL INDEX OF ARBORETUMS AND BOTANICAL GARDENS DESCRIBED IN THE DIRECTORY

(with a map)

ARBORETUMS and BOTANICAL GARDENS in NORTH AMERICA
WITH HARDINESS ZONES



Holden Arboretum, *Kirtland Hills, Ohio* .... (56)
Horticultural Hall and Arboretum, West Fairmount Park, *Philadelphia, Pa.* .... (67)
Walter Hunnewell Arboretum, *Wellesley, Mass.* .... (35)
Huntington Botanical Garden, *San Marino, Calif.* .... (8)
Huntington College Botanical Garden and Arboretum, *Huntington, Ind.* .... (23)
Indian Hill Arboretum, *Topeka, Kansas* .... (27)
Institute of Forest Genetics, *Placerville, Calif.* .... (6)
Iowa State College Arboretum, *Ames, Iowa* .... (26)
Lexington (Mass.) Botanic Garden, Inc., *Lexington, Mass.* .... (31)
Lilacia Park, *Lombard, Ill.* .... (22)
Long Island Agricultural and Technical Inst., *Farmingdale, New York* .... (45)
Longwood Gardens, *Kennett Square, Pa.* .... (60)
Magnolia Gardens, *Charleston, South Carolina* .... (73)
Marsh Botanical Garden, *New Haven, Conn.* .... (11)
Masonic Home Arboretum, *Elizabethtown, Pa.* .... (58)
Maymont Park, *Richmond, Virginia* .... (77)
McIllhenny Arboretum, *Avery Island, Louisiana* .... (28)
McKee Jungle Gardens, *Vero Beach, Florida* .... (17)
Mead Botanical Garden, *Winter Park, Florida* .... (18)
Missouri Botanical Garden, *St. Louis, Mo.* .... (40)
Montreal Botanical Garden, *Montreal, Canada* .... (84)
Morris Arboretum, *Philadelphia, Pa.* .... (68)
Morton Arboretum, *Lisle, Illinois* .... (21)
Mt. Airy Forest Arboretum, *Cincinnati, Ohio* .... (53)
National Arboretum, *Washington, D.C.* .... (13)
National Botanic Garden, *Washington, D.C.* .... (14)
New York Botanical Garden, *New York, New York* .... (48)
New York State Experiment Station, *Geneva, New York* .... (46)
Niagara Parks Commission's School for Apprentice Gardeners, *Niagara Falls, Ontario, Canada* .... (86)
Nichols Arboretum, *Ann Arbor, Michigan* .... (36)
Phipps Conservatory, *Pittsburgh, Pa.* .... (69)
Rancho Santa Ana Botanic Garden, *Anaheim, Calif.* .... (3)
Reef Point Gardens, *Bar Harbor, Maine* .... (29)
Stanley M. Rowe Arboretum, *Cincinnati, Ohio* .... (54)
Royal Botanical Gardens, *Hamilton, Ontario, Canada* .... (82)
Santa Barbara Botanic Garden, *Santa Barbara, Calif.* .... (9)
Skylands Nursery, *Sloatsburg, New York* .... (51)
Slayton Arboretum and Botanical Garden, *Hillsdale, Mich.* .... (37)
Smith College Arboretum, *Northampton, Mass.* .... (32)
State Forest Arboretum, *Mont Alto, Pa.* .... (63)
Strybing Arboretum at Golden Gate Park, *San Francisco, Calif.* .... (7)
John J. Tyler Arboretum, *Lima, Pa.* .... (61)
University of British Columbia Botanical Gardens, *Vancouver, British Columbia, Canada* .... (89)
Univ. of California Botanical Garden, *Berkeley, Calif.* .... (4)
Univ. of Florida Sub-tropical Experiment Station, *Homestead, Fla.* .... (16)
University of Washington Arboretum, *Seattle, Wash.* .... (79)
University of Wisconsin Arboretum, *Madison, Wis.* .... (80)
Westtown School Arboretum, *Westtown, Pa.* .... (72)
Wind River Arboretum, *Carson, Wash.* .... (78)
Wooster Arboretum, *Wooster, Ohio* .... (57)

SMALL COLLECTIONS OF SPECIAL PLANTS

It is impossible to give a satisfactory list of the public institutions, commercial organizations and private individuals specializing in the growing of any one kind of plant. This has been done in the past. The American Rose Society has published extensive lists of rose gardens. Collections of plants less permanent than trees or shrubs, such as tulips or asters or gladiolus are always more or less temporary. A collection which has been complete one year may not even exist the next. Circumstances may have been such that either through sale of the land, death of the owner, lack of interest or a sudden lack of funds the collection may have been entirely removed.

Nor is it possible for one individual to know all the growers worthy of mention, especially in an area as large as North America. The list merely includes a few of the growers specializing in certain kinds of plants. Commercial concerns are understandably quick to point out the injustice of such lists, especially when a few commercial sources are listed. As a result, fifty commercial sources in the original list were removed, making it of considerably less value for it are the commercial specialists who usually have more varieties displayed than any other source. However, the Massachusetts Horticultural Society will probably publish in 1948 a new Plant Buyer's Index of commercial sources for all the plants grown in the United States.

The following list is not offered as a commercial source for materials. It is *given merely as a list of a very few places where certain groups of plants can be observed in a large number of varieties.*

Abies:—

Arnold Arboretum.
Westtown School Arboretum.

Azaleas:—

Arnold Arboretum.
Bellingrath Gardens (Mobile, Alabama).
Cypress Gardens (Oakleigh, South Carolina).
EVERITT, Mr. and Mrs. S. A. (Huntington, New York)
Florida Agricultural Experiment Station (Gainesville, Florida).
GABLE, JOSEPH B. (Stewartstown, Pennsylvania).
Gerbing Gardens (Fernandina, Florida).
Killearn Gardens (Tallahassee, Florida).
LEE, FREDERIC P. (Washington, D. C.)
Magnolia Gardens.
Middleton Gardens (Charleston, South Carolina).
Morris Arboretum.

Morrison, Benjamin Y. (Takoma Park, Washington, D. C.)
National Arboretum.
Roger Lacy Gardens (Longview, Texas).
University of Washington Arboretum.
Warinanco Park (Elizabeth, New Jersey).
Wormsloe Gardens (Savannah, Georgia).

Bamboos:—
Baker, Rev. Christian L. (Saint Augustine's Seminary, Bay St. Louis, Mississippi).
Barbour Lathrop Plant Introduction Garden (Savannah, Georgia).
Golden Gate Park (San Francisco, California).
McIlhenny, Mr. E. A. (Avery Island, Louisiana).
Sturkie, Dr. (Auburn, Alabama; Experiment Station).
U.S.D.A. Bureau Plant Introduction Station (Glenn Dale, Maryland).

Begonias:—
New York Botanical Garden.
Rich, Howard S. (Atlantic, Maine).
Many places on the Pacific Coast.

Boxwoods:—
Missouri Botanical Garden
Morris Arboretum.

Buddleia:—
Blandy Experimental Farm.
Dominion Botanic Garden and Arboretum (Ottawa, Ontario, Canada).

Cacti:—
Atkins Garden and Research Laboratory.
Desert Botanical Garden (Phoenix, Arizona).
Fort Worth Botanic Garden.
Gates Baja California Botanical Garden (Corona, Calif.).
Huntington Botanic Garden.
Rancho Santa Ana Botanic Garden.
Boyce Thompson Southwestern Arboretum.
University of California Botanical Garden (Berkeley, Calif.).

Camellia:—
Bellingrath Gardens (Mobile, Alabama).
Capitol Park (Sacramento, California).
Florida Agricultural Experiment Station (Gainesville, Florida).
Gerbing Gardens (Fernandina, Florida).
Killearn Gardens (Tallahassee, Florida).
Magnolia Gardens (Charleston, South Carolina).
Middleton Gardens (Charleston, South Carolina).

Caragana:—
Arnold Arboretum.
Dominion Botanic Garden and Arboretum (Ottawa, Ontario, Canada).
Experimental Farm (Morden, Manitoba, Canada).

Ceanothus:—
Mills College (Oakland, California).
La Purisima Mission (Lompoc, California).
Rancho Santa Ana Botanic Garden.
Santa Barbara Botanic Garden.

Chrysanthemums:—
Arthur Hoyt Scott Horticultural Foundation.
Chrysanthemum Test Gardens (Portland, Oregon).
New York Botanical Garden.
University of Chicago, Illinois, Test Gardens (Wychewood, Lake Geneva, Wisconsin).

Clematis:—
Morris Arboretum.
New York Botanical Garden.

Collections of Interesting Plants:—
Berkshire Garden Center (Stockbridge, Mass.).
Bohlin Arboretum (Chesterton, Indiana).
Cave Hill Cemetery (Louisville, Kentucky).
Coker Arboretum (University of North Carolina, Chapel Hill, N.C.).
George School Campus (George School, Penna.).
Hall Arboretum (Oberlin, Ohio).
Haverford College Campus (Haverford, Penna.).
Hoyt Park Arboretum (Portland, Oregon).
John H. Holliday Park (Indianapolis, Indiana).
Leila Arboretum (Battle Creek, Michigan).
Lyndonwold (Lyndonville, New York).
Mills College (Oakland, California).
Pack Memorial Arboretum (Trenton, New Jersey).
Peavy Arboretum (Corvallis, Oregon).
Pennsylvania State College (State College, Penna.).
Pinetum Claytonese (Roslyn, New York).
Princeton University Campus (Princeton, New Jersey).
Proctor Arboretum (Topsfield, Mass.).
South Dakota Agr. Exp. Station (Brookings, South Dakota).
Spring Grove Cemetery (Cincinnati, Ohio).
University of Kentucky Arboretum (Lexington, Kentucky).
University of New Hampshire Arboretum (Durham, N. H.).
Vassar College Campus (Poughkeepsie, New York).
All nurseries throughout the United States and Canada.

Cornus:—
Arnold Arboretum.
Cedar Brook Park (Plainfield, New Jersey).
Dominion Botanic Garden and Arboretum.
Morton Arboretum.
Valley Forge Park (Valley Forge, Penna.).

Dahlias:—
CURRIE, Mr. GEORGE R. (Sheboygan, Wisconsin).
DUDLEY, Mr. LYNN B. (25 Irving Place, New Rochelle, New York).
LLOYD, Mr. EDWARD B. (10 Crestmont Road, Montclair, New Jersey).
WASSER, Mr. GORDON F. (378 Pennsylvania Avenue, Freeport, L. I., N.Y.).
WIND, Mr. E. J. (19111 Story Road, Rocky River 16, Ohio).

Desert Plants:—
Atkins Garden and Research Laboratory.
Boyce Thompson Southwestern Arboretum.
Desert Bot. Garden (Phoenix, Arizona).
Garfield Park Conservatory.
Huntington Botanical Garden.

Eucalyptus:—
Boyce Thompson Southwestern Arboretum.
Huntington Botanical Garden.

Ferns:—
Arboretum of the Barnes Foundation.
Bowman's Hill State Wild Flower Preserve (New Hope, Penna.).
Garfield Park Conservatory.
Missouri Botanical Garden.
Morris Arboretum.

Fruits:— Most of the State and Federal Experiment Stations have catalogued collections of fruits. Some might be:

Dominion Experimental Farm (Ottawa, Canada) and all sub-stations.
Florida Agricultural Experiment Station (Gainesville, Florida).
Illinois Agricultural Experiment Station (Urbana, Illinois).
Iowa State Experiment Station (Ames, Iowa).
New York State Experiment Station (Geneva, New York).
South Dakota Agricultural Experiment Station (Brookings, South Dakota).
U.S. Department of Agriculture, Citrus Experiment Station (Chico, Cal.).
U.S. Department of Agriculture Experiment Station (Beltsville, Md.).
University of Florida Sub-Tropical Experiment Station.
Washington Agricultural Experiment Station (Pullman, Washington).

Fuchsia:—
Golden Gate Park (San Francisco, Calif.).
REITER, VICTOR (1095 Stanyan Street, San Francisco, Calif.).

Gladiolus:—
MOSES, ALFRED L. (Lima, New York).
SALBACH, CARL (657 Woodmont Avenue, Berkeley 8, Calif.).

Ground Cover Demonstration:—
Ohio State University Campus (Columbus, Ohio).

Grasses:—
Associated Seed Growers (New Haven, Conn.).
Bureau of Plant Industry (Beltsville, Maryland).
Everglades Experiment Station (Belle Glade, Florida).
Georgia Coastal Plain Experiment Station (Tifton, Georgia).
Missouri Experiment Station (Columbia, Missouri).
Nebraska Experiment Station (Lincoln, Nebraska).
New York Agricultural Experiment Station (Ithaca, N.Y.).
Oklahoma Agric. and Mech. College (Stillwater, Oklahoma).
Oregon State College (Corvallis, Oregon).
Pennsylvania State College (State College, Penna.).
Purdue University (West Lafayette, Indiana).
Rhode Island Experiment Station (Kingston, R.I.).
Soil Conservation Service (Introduction Nurseries, Beltsville, Md.).
Texas Agric. and Mech. College (College Station, Texas).
Washington State College (Pullman, Washington).
Wisconsin Agricultural Experiment Station (Madison, Wisc.).

Hedera sp.:—
Brooklyn Botanic Garden.
Cornell Plantations.
Morris Arboretum.

Hedges:—
Arnold Arboretum.
Cornell Plantations.
Dominion Experimental Farm (Ottawa, Canada).
Morton Arboretum.
Ohio State Univ. Campus (Columbus, Ohio).
University of Massachusetts (Amherst, Mass.).

Hemerocallis:—
Arthur Hoyt Scott Horticultural Foundation.
New York Botanical Garden.

Herbs:—
Berkshire Garden Center (Stockbridge, Mass.).
Brooklyn Botanic Garden.
Kitchen Garden at Mount Vernon (Virginia).
Montreal Botanical Garden.
New York Botanical Garden.
Philadelphia College of Pharmacy (Philadelphia, Penna.).
U.S. Department of Agriculture Station (Beltsville, Md.).

Historic Garden:—
Bartram's Garden (Philadelphia, Penna.).

Ilex:—
Arnold Arboretum.
Arboretum of the Horticultural Farm, New Jersey Agricultural Experiment Station (New Brunswick, New Jersey).
Masonic Home Arboretum.

Iris:—
Arboretum of the Horticultural Farm (New Brunswick, New Jersey).
Arthur Hoyt Scott Horticultural Foundation.
Bent, Harold (Framingham Center, Mass.).
Cedar Brook Park (Plainfield, New Jersey).
Eylar, F. B. (Renton, Washington).
Lexington Botanic Garden.

Juniperus:—
Arnold Arboretum.
Cornell Plantations.
Iowa State College Arboretum.
Morton Arboretum.

Lilies:—
Boyce Thompson Institute Arboretum.
Dominion Experimental Farm (Ottawa, Canada).
MacNeil, Alan (North Springfield, Vermont).
U.S. Department of Agriculture Station (Beltsville, Maryland).

Magnolias:—
Arnold Arboretum.
Arthur Hoyt Scott Horticultural Foundation.
Coleman Hill Memorial (Macon, Georgia).
Holden Arboretum.
Morton Arboretum.
Rochester Parks (Rochester, New York).
Strybing Arboretum at Golden Gate Park.
University of Washington Arboretum.

Malus:—
Arnold Arboretum.
Arthur Hoyt Scott Horticultural Foundation.
Botanic Garden and Arboretum (Ottawa, Canada).
Des Moines Water Works (Des Moines, Iowa).
Experimental Farm (Morden, Manitoba, Canada).
Holden Arboretum.
Missouri Botanical Garden.
Morton Arboretum.
Rochester Parks.
Slayton Arboretum and Botanic Garden.

Medicinal Plants:—
Brooklyn Botanic Garden.
Buffalo Botanic Garden.
Massachusetts College of Pharmacy (Garden at Arnold Arboretum).
Montreal Botanical Garden.
Morton Arboretum.
Ohio Agricultural Experiment Station (Ohio State University).
Parke-Davis Co. (Parksdale, Michigan).
Philadelphia College of Pharmacy (Philadelphia, Penna.).
Rhode Island College of Pharmacy (Providence, R.I.).
U.S. Department of Agriculture Station (Beltsville, Md.).
University of Minnesota (College Farm, St. Paul, Minn.).
Washington Agricultural Experiment Station (Pullman, Wash.).

Narcissus:—

Arthur Hoyt Scott Horticultural Foundation.
Cedar Brook Park (Plainfield, New Jersey).

Orchids:—

ALBERTS, BRUNO (Mandarin, Florida).
BALDWIN, GEORGE E. (Mamaroneck, New York).
Cornell University (Ithaca, New York).
Garfield Park Conservatory.
JONES, RODNEY WILCOX (100 Broadview Avenue, New Rochelle, New York).
Mead Botanical Gardens (Winter Park, Florida).
Missouri Botanical Garden.
New York Botanical Garden.
Orchid Jungle (Homestead, Florida).
United States Botanical Gardens (Washington, D.C.).
University of Pennsylvania (Dept. of Botany) (Philadelphia, Pa.).
YARIAN, Dr. NORMAN (7405 Detroit Avenue, Cleveland, Ohio).

Palms:—

Atkins Garden and Research Laboratory.
Balboa Park (San Diego, Calif.).
Fairchild Tropical Garden.
Huntington Botanical Garden.
Santa Barbara Botanic Garden.

Peony:—

Arboretum of Horticultural Farm (New Jersey Agricultural Experiment Station, New Brunswick, New Jersey).
Arthur Hoyt Scott Horticultural Foundation.
AUTEN, EDWARD, Jr. (Princeville, Ill.).
BARCLAY, F. H. (3401 Oakfield Avenue, Baltimore 7, Md.).
Cedar Brook Park (Plainfield, New Jersey).
GAYLE, ROY G. (R.R. 3, West State Road, Rockford, Ill.).
JONES, R. H. (Tuckdawa, Peru, Indiana).
LEIGHTON, ROY S. (Edmonds, Washington).
LONG, POPE M. (Cordova, Ala.).
MILLER, WALTER F. (Sun Prairie, Wis.).
MURAWSKA, A. L. (8740 Ridge Street, River Grove, Ill.).
NAPIER, RICHARD A. (2656 Walnut Street, Blue Island, Ill.).
Nichols Arboretum.
SAUNDERS, A. P. (Clinton, New York).
University of Illinois Test Plots (Urbana, Ill.).

Tree Peony:—

Arthur Hoyt Scott Horticultural Foundation.
GRATWICK, WILLIAM (Linwood, New York).
SAUNDERS, A. P. (Clinton, New York).

Perennials:—

Arboretum of the Horticultural Farm (New Jersey Agricultural Experiment Station, New Brunswick, New Jersey).
Botanic Garden, Charles B. Whitnall Park.
Cornell Plantations.
Garden in the Woods.
Lexington Botanic Garden.
Masonic Home Arboretum.
Montreal Botanical Garden.
New York Botanical Garden.
Royal Botanical Gardens.
Slayton Arboretum and Botanical Garden.
State Institute of Applied Agriculture (Farmingdale, L.I., New York).
University of British Columbia Botanical Garden.

Waltham Field Station (University of Massachusetts Agricultural Experiment Station, Waltham, Mass.).

Philadelphus:—
Arnold Arboretum.
Morton Arboretum.

Phlox:—
Blandy Experimental Farm.
Lexington Botanic Garden.

Picea:—
Arnold Arboretum.
Morton Arboretum.
Westtown School Arboretum.

Pinus:—
Arboretum of the Institute of Forest Genetics (Placerville, Calif.).
Arnold Arboretum.
Blandy Experimental Farm.
Rancho Santa Ana Botanic Garden.
University of Washington Arboretum.
Westtown School Arboretum.

Plants of Temperate South America:—
University of California Botanical Garden (Berkeley, Calif.).

Oriental Poppies:—
A. E. Curtis (5930 Argus Road, Cincinnati 24, Ohio).
Fairmont Iris Garden (Lowell, Mass.).

Rhododendrons:—
Arnold Arboretum.
Arthur Hoyt Scott Horticultural Foundation.
English, Carl S. (8546, 30th Avenue, N.W., Seattle, Wash.).
Everitt, S. A., Mr. and Mrs. (Huntington, N.Y.).
Graham, Donald (Seattle, Wash.).
Greene, W. A. (Seattle, Wash.).
Walter Hunnewell Estate Arboretum.
Ihrig, Herbert (Seattle, Wash.).
Morris Arboretum.
Reber, E. L. (Seattle, Wash.).
Strybing Arboretum at Golden Gate Park.
Thorgrimson, O. B. (Seattle, Wash.).
University of California Botanical Garden (Berkeley, Calif.).
University of Washington Arboretum.

Rose Species:—
Arnold Arboretum.
Breeze Hill Gardens.
Holden Arboretum.
Morton Arboretum (Old Fashioned roses).

Official Rose Test Gardens of the American Rose Society:—
Cornell Test Gardens (Ithaca, New York).
Elizabeth Park (Hartford, Conn.).
International Rose Test Garden (Portland, Oregon).
Iowa State College (Ames, Iowa).
Los Angeles County Arcadia Park (Arcadia, Calif.).
Michigan State College (East Lansing, Michigan).
Municipal Rose Garden (Missoula, Montana).
Ohio State University (Columbus, Ohio).
Virginia Agricultural Experiment Station Garden (Blacksburg, Virginia).
Woodland Park Rose Garden (Seattle, Wash.).

Rose Display Gardens:—
Hershey Rose Gardens (Hershey, Penna.).
Over one hundred municipal gardens listed in the Members Handbook of the American Rose Society 1946-47.

Rubus:—
Connecticut Arboretum.

Salix:—
Montreal Botanical Garden.
Morton Arboretum.

Street Trees:—
Cleveland Street Tree Demonstration Plot (Brecksville, Ohio).

Sub-Tropical Plants:—
Fairchild Tropical Garden.
Huntington Botanical Garden.
MENNINGER, EDWIN A. (Stuart, Florida).
Strybing Arboretum at Golden Gate Park.
University of California Botanical Garden (Los Angeles).
University of Florida Sub-Tropical Experiment Station.

Succulents:—
Atkins Garden and Research Laboratory.
Boyce Thompson Southwestern Arboretum.
Buffalo Botanic Garden.
Desert Botanic Garden (Phoenix, Arizona).
Garfield Park Conservatory.
Huntington Botanical Garden.
Missouri Botanical Garden.
New York Botanical Garden.
Rancho Santa Ana Botanic Garden.
University of California Botanical Garden (Berkeley, Calif.).

Syringa:—
Arnold Arboretum.
Arthur Hoyt Scott Horticultural Foundation.
Dominion Experimental Farm (Ottawa, Canada).
Holden Arboretum.
HUMPHREY, Mr. and Mrs. E. W. (Belmont Road, R.D. 2, Butler, Pa.).
Lilacia Park (Lombard, Ill.).
Masonic Home Arboretum.
Morton Arboretum.
Rochester Parks (Rochester, New York).
SCOTT, Mrs. ARTHUR HOYT (Media, Pa.).
Slayton Arboretum and Botanic Garden.

Taxus:—
Arnold Arboretum.
Morton Arboretum.
Wooster Arboretum.

Tropical Plants:—
Atkins Garden and Research Laboratory.
Fairchild Tropical Garden.
Mead Botanical Garden.

Tsuga:—
Hemlock Arboretum.

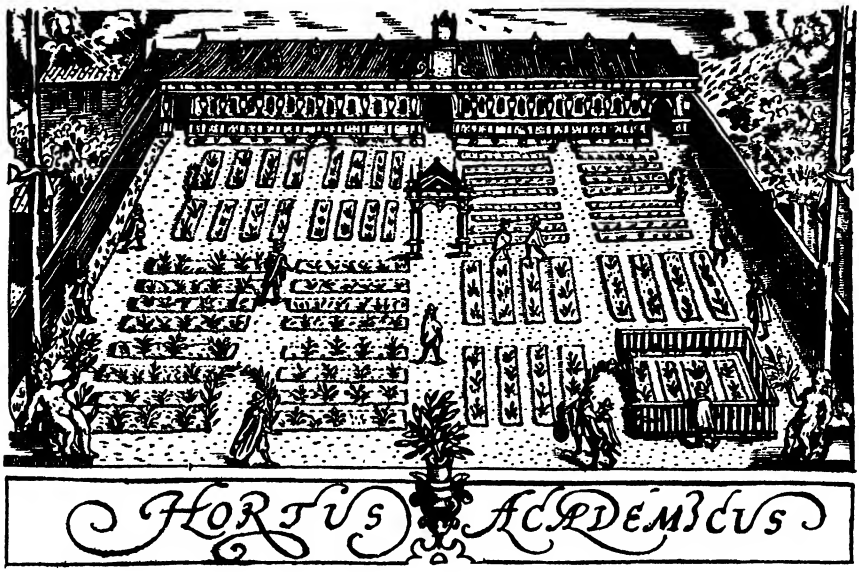
Tulips:—
Holland Parks (Holland, Michigan).
Lambert Gardens (Portland, Oregon).
Lilacia Park (Lombard, Ill.).

Viburnum:—
- Arnold Arboretum.
- Holden Arboretum.
- Morton Aboretum.
- University of Washington Arboretum.

Water Lilies:—
- Brooklyn Botanic Garden.
- Experimental Farm (Morden, Manitoba, Can.).
- Garfield Park Conservatory.
- Missouri Botanical Garden.
- Montreal Botanical Garden.
- New York Botanical Garden.

Wisterias:—
- Arnold Arboretum.
- Skylands Nursery.

THE ATTRACTIVE COLOPHON USED BY THE BROOKLYN BOTANICAL GARDEN ON ITS PUBLICATIONS, PROGRAMMES, GUIDES, ETC.



BIBLIOGRAPHY

— *Cf. the notes on page 400* —

ANON., **"Botanische Gärten"**, Bonplandia 1:113-114, 125-127, 1853.

ANON., **"The Value of Botanic Gardens"**, Agric. News (Barbados) 19:193, 1920.—Abstract in Bot. Abstr. 7:10, 1921.

ANON., **"Conférence sur l'Organisation des Parcs et Jardins"**, Bull. Jard. Bot. Princip. U.R.S.S. 29:197-214, 215-216, 1930.—In Russian.

M. F. AREY, **"County Parks"**, Rept. Iowa State Bd. Conservation, 1919, p. 290-292.—On county parks to combine the features of national and city parks and serving at the same time as arboretums.

R. P. AHLQUIST, **"The Drug Garden as a teaching aid in Pharmacognosy"**, Indian Jour. Pharm. 5:175-177, 1943.

L. H. BAAS BECKING, **"De Verzameling Houtgewassen, hare Ontwikkeling tot Arboretum en de Moderne Eischen voor de Inrichting hiervan"**, Veenman, Wageningen, pp. 99, 1917.

W. J. BEAL, **"Botanic Gardens"**, Bot. Gaz. 23:51-52, 1897.

E. D. BENNETT, **"Arboreta and Botanic Gardens in the U.S."**, Gard. Chron. 90:315-316, 1931.

A. F. BLAKESLEE, **"The Botanic Garden as a Field Museum of Agriculture"**, Science II, 31:685-688, 1910.

J. BRELOER, **"Dendrologie und neuzeitlicher Garten"**, Mitt. Dtsch. Dendrol. Ges. 43: 382-388, 1931.

N. L. BRITTON, **"Botanical Gardens"**, Ga. and For. 9:352-353, 362-363, 1896.

N. L. BRITTON, **"Relations of Botanical Gardens to the Public"**, Journ. New York Bot. Gard. 11:25-30, 1910 and Science II, 31:641-644, 1910.

Mrs. S. B. BRYANT, **"The Place of a Botanic Garden in Time of War"**, Gard. Club Amer. Bull., ser. 9, No. 6:12, 1944.—Chiefly on the Rancho Santa Ana Garden.

E. BURNAT, **"Notes sur les Jardins Botaniques Alpins"**, Bull. Soc. Murithienne, 26 (Append.) : 1-16, 1897.—Followed by discussions by H. CHRIST and JOHN BRIQUET. —Abstr. in Bot. Centralbl. 78:43, 1899.

A. P. DE CANDOLLE, **"Notice abrégée sur l'Histoire et l'Administration des Jardins Botaniques"**, Paris, 1822.

L. J. CLARKE, **"The Botany Gardens of the James Allen's Girls School, Dulwich"**, Board of Education, Educational Pamphlet No. 41, 1922.—Review in Nature 110:329-330, 1922.

M. Colmeiro y Penido, "**Los Jardines Botánicos, su Numero, Organización é Importancia en las Naciones, más cultas é ilustradas**", Madrid, 1894.

G. D. Cooper, "**Arboretums, Their Aims and Scope**".—At present in manuscript form but about to be published.

J. M. Coulter, "**The Social, Educational and Scientific Value of Botanic Gardens**", Science II, 45:643-647, 1917 and Smithsonian Rept. for 1917, p. 463-468, 1919.

L. Croizat, "**Mapping The Arboretum**", Arnoldia Vol. 6, No. 5, 1938.

B. Cronberger, "**Der Schulgarten des In- und Auslandes. Eine Darstellung seiner volkswirtschaftlichen und pädagogischen Bedeutung auf Grund bestehender Einrichtungen zur Förderung ähnlicher Anlagen**", A. Blažek jun., Frankfurt a. M., pp. 176, 1898.—An interesting, early publication, with 8 plans.

A. Cugnac, "**Les Jardins Botaniques et la Conservation des Espèces Rares**", Bull. Mus. Hist. Nat. 8:286-289, 1936.

K. Dageförde (Jr.), "**Der Biologische Schulgarten als unterrichtliches und erziehliches Hilfsmittel**", Gartenflora 77:298-300, 1928.

J. Decaisne, "**Nouvelle Organisation des Jardins de Botanique**", Paris, 1852.

L. Diels, "**Führungen im Botanischen Garten**", in: "Der biologische Lehrausflug", ed. W. Schoenichen, G. Fischer, Jena, 1922.

Dodman, "**Ueber die Anwendung der Sammlungen, welche für öffentliche Gärten auf Staatsunkosten gemacht werden**", Bot. Z. 10:132, 1852.

Dodman, "**Botanical Gardens**", Ga. Chron. I, 12:21, 1852.

A. Engler, "**Die Pflanzenformationen und die pflanzengeographische Gliederung der Alpenkette, erläutert an der Alpenanlage des neuen königl. botanischen Gartens zu Dahlem-Steglitz bei Berlin**", Notizbl. K. Bot. Garten, Berlin, Append. 7, pp. 96, 1901. — This, and the two following classic papers exercised much influence.

A. Engler, "**Die pflanzengeographische Gliederung Nordamerikas, erläutert an der nordamerikanischen Anlage des neuen königl. bot. Gartens zu Dahlem-Steglitz bei Berlin**", Notizbl. K. Bot. Garten, Berlin, Append. 9, pp. 94, 1902.

A. Engler, "**Die Pflanzenformationen und die pflanzengeographische Gliederung der Alpenkette, erläutert an der Alpenanlage des neuen botan. Gartens zu Dahlem-Steglitz bei Berlin**", ed. 2, Leipzig, pp. 96, 1903.

A. Engler, "**Die Aufgaben grosser botanischer Gärten und Museen mit besonderer Berücksichtigung des Botanischen Gartens und Museums zu Dahlem . . .**", p. 1-9 of "Der Kgl. botanische Garten und das kgl. botanische Museum zu Dahlem . . .", 1909.

D. Fairchild, "**Gardens for Plant Breeders**", Jour. of Heredity 9:112-116, 1918. — The author's four well known volumes of horticultural travel and reminiscences contain also much on the organization of scientific gardens and related problems.

R. Fischer, "**Der Schulgarten im Wandel der Zeiten**", Frankfurt a.O., Trowitzsch, pp. 78, 1939.—The most informative, recent account on this subject.

J. Fletscher, "**The Educational Value of Botanic Gardens**", The Naturalist (Ottawa Field Naturalists Club) 5:105.

C. S. Gager, "**Ideals and Opportunities for a Botanic Garden**", Brooklyn Bot. Gard. Rec. 6:121-131, 1917 and Science II, 45:648-653, 1917.

C. S. Gager, "**The Educational Value of a Botanic Garden**", Museum Work 7:3-10, 1924.

C. S. Gager, "**The Educational Value of the Brooklyn Botanic Garden**", Ninth Intern. Hortic. Congr., p. 410-413, London, 1930.

C. S. Gager, "**Botanic Gardens in Science and Education**", Science II, 85:393, 1937.

C. S. Gager, "**Botanic Gardens of the World**", Brooklyn Bot. Gard. Rec. 27:151-406, 1938. — Second, revised edition.

W. F. Ganong, "**The Place of Botanical Gardens in Collegiate Instruction**", Science II, 31:644-648, 1910. — Moreover, much material of a general and timely interest may be found in the author's accounts of the Smith College Botanical Garden.

P. Geddes, "**A Type Botanic Garden**", Trans. Bot. Soc. Edinburgh 16:61-64, 1883.

R. J. H. Gibson, Presidential Address "**On Botanic Gardens—Past and Present**", Trans. Biol. Soc., Liverpool, vol. 10, 1895.

M. R. Gilmore, "**A Living Outdoor Museum**", Mus. Work 3:144-153, 1921.

Gartenflora.—For early lists of Botanical Gardens by REGEL and v. HERDER *vide* vols. 11, 14, 15, and 21.
M. R. GILMORE, **"The Indian Garden"**, Indian Notes *3*:209-213, 1926.—On the Am. Ethnobotanic Garden of the Heye Foundation, New York City.
H. R. GÖPPERT, **"Der königliche botanische Garten der Universität Breslau"**, Heyn'sche Buchhandlung (E. Remer), Görlitz, pp. 96, 1857.—Wih much general material, a classic paper which had a considerable influence.
H. R. GÖPPERT, **"Ueber die Drogen-Aufstellung im botanischen Garten der Universität Breslau"**, Hahn'sche Hofbuchhandlung, Hannover, 1859.—GOEPPERT wrote many other papers of a similar nature which exercised considerable influence, especially also on his successor, ADOLF ENGLER. A list of GOEPPERT'S writings on this subject will be found at the end of his "Cat. der Botan. Museen . . . Breslau", 1884. Of much influence also was his address at the Int. Hortic. Congress in London of 1866 on alpine gardens (*cf.* J. Bot. 4:205, 1866).
G. L. GOODALE, **"Botanic Gardens in the Equatorial Belt and in the South Seas"**, New Haven, 1891.
Graz.—**"Ein Schulgarten für grössere Städte,** Publicationen der k. k. Gartenbau-Gesellschaft in Steiermark zu Graz, I. P. Parey, Berlin, pp. 36, 1889.
M. L. GREENE, **"Among School Gardens"**, Russell Sage Found., New York City, pp. 388, 1910.
A. GUILLAUMIN, **"Quelques Observations à propos des Jardins Botaniques d'Angleterre et de Belgique"**, Bull. Mus. Hist. Nat. Paris 2:696-697, 1930.
A. HÄSSLER, **"Uber den Zweck und die Methodik der Bestimmungsarbeiten in unseren botanischen Gärten nebst ihren Beziehungen zur Nomenklatur in der Gärtnerei"**, Gartenbauwissenschaft 3:476-479, 1930.
C. HANSEN, **"Quel est le meilleur Système d'Étiquettes; pour Jardins botaniques, pour Parcs publics, pour Jardins privés, pour Serres?"**, Gand, 1885.
J. W. HARSHBERGER, **"Ethno-Botanic Gardens"**, Science II, 3:203-205, 1896.
M. HERBERG, **"Der Schulgarten"**, Leipzig, 1928.
A. W. HILL, **"The History and Functions of Botanic Gardens"**, St. Louis, 1915.
F. C. HOEHNE, **"Dos jardins botanicos. Esclarecimento sobre seus fins e sua natureza"**, Sec. da Agr. Indús. e Com., São Paulo, Dir. de Publicidade Agr., Notas Agr. 6:90-94, 1943.
A. HOGSTAD, Jr., **"The Medicinal Plant Garden and the Pharmacist"**, Northwestern Druggist *27*:389-391, 1919.—Abstr. in Bot. Abstr. 3:277, 1920.
H. J. HOWE, **"Arboreta"**, Parks and Recreation *27*:226-230, 1944.
J. IVOLAS, **"Les Jardins Alpins. Description, Organisation, Ressources, etc. de ceux actuellement connus en Europe"**, Paris, pp. 100, 1908.
J. H. JAGER GERLINGS, **"Aan welke eischen moet een Boschbouwarboretum voldoen?"**, Nederl. Boschbouw Tijdschrift, Vol. 11, 1938.
C. L. JAHN, **"Auf welche Weise lassen sich die zoologischen Museen, botanischen und zoologischen Gärten etc. am zweckmässigsten für den naturgeschichtlichen Unterricht verwerten?"**, Berliner Blätter, No. 15, p. 113-118, 1866.
D. C. JOHNSON, **"A University Botanical Garden"**, Science II, 31:648-655, 1910.
F. JÜHLKE, **"Die botanischen Gärten mit Rücksicht auf ihre Benutzung und Verwaltung"**. Kittler, Hamburg, pp. 16, 1849. — Refers chiefly to TREVIRANUS' "Über die Führung" (*q. v.*).
A. KERNER VON MARILAUN, **"Die botanischen Gärten, ihre Aufgabe in der Vergangenheit, Gegenwart und Zukunft"**, Innsbruck, 1874.
K. KOCH, **"Die Botanischen Gärten"**, Riegel, Berlin, pp. 70, 1860.—Rev. in Gartenflora 10:224, 1861.
D. T. MACDOUGAL, **"Botanic Gardens"**, Appleton's Pop. Science Monthly, Dec. 1896 and Jan. 1897.
S. MACGREGOR, **"An Ecologist's Garden"**, N. Phytologist 10(1/2):64-68, 1911.
T. B. MCQUESTEN, **"Arboretums, their Place in Park Development"**, Parks and Recreation, pp. 32-34, Sept.-Oct., 1942.
J. H. MAIDEN, **"Functions of a Botanic Garden, and some local Ideals and Suggestions"**, Jour. Proc. R. Soc. N. S. Wales 46:49-73, 1912.
M. MIRANDE, **"Les Jardins Alpins et leurs Buts"**, Ann. Univ. Grenoble 23:5-49, 1911.

J. W. Moll, **"De Boekhouding der Planten van een Botanischen Tuin"**, Verh. Kon. Acad. v. Wetensch., 2e sectie, Vol. 5, Amsterdam 1897.

R. Pyle, **"A Directory of Botanical Gardens and Arboretums of the United States"**, Proc., 64th Annual Convention, Americ. Assoc. of Nurserymen, p. 123-157, 1939.—Third edition of Mr Pyle's classic list.

R. Pyle, **"Botanical Gardens"**, Amer. Nurseryman 80(2) :18-19, 1944; 82(2) :18, 1945.

C. Regel, **"Der Botanische Garten der Neuzeit"**, Gartenflora 77:155-159, 1928.

C. Regel, **"Der Botanische Garten der Neuzeit"**, Rep. and Proc. 9th Intern. Hortic. Congr., London, p. 405-409, 1930.

E. Regel, **"Botanische Gärten"**, Gartenflora 8:67-81, 1859.—Classic, general considerations, later continued by a number of short notes on contemporary gardens.

H. H. Reiter, **"Der ökologisch-biologische Schulgarten"**, pp. 38, 1913.

D. F. L. v. Schlechtendal, **"Eine Aufgabe für die Botanischen Gärten"**, Bot. Z. 16:105, 1858.

C. Schmitt, **"Der biologische Schulgarten, seine Anlage und unterrichtliche Verwertung"** ed. 2, Datterer and Cie., Freising, Germany, pp. 112, (n.d., ed. 1 is of 1908).

A. Seifert, **"Gärten in den Alpen"**, Jahrb. Ver. z. Schutze der Alpenpflanzen 3:36-48, 1931.

H. Teuscher, **"Program for an Ideal Botanical Garden"**, Memoirs of the Montreal Botan. Garden 1:1-32, 1940.—Most inspiring of recent papers.

F. Tölg, **"Ueber Lehrgärten"**, Jahresber. k.k. Staatsgymn., Saaz, part 1, pp. 22, 1910; part 2, pp. 35, 1911.

W. Trelease, **"The Administration of Botanical Gardens"**, Science II, 31:681-685, 1910.—An address delivered at the occasion of a symposium on botanical gardens, during the Boston Meetings of the A.A.A.S., 1909, *cf.* also Britton 1910, Ganong 1910, and Johnson 1910.

L. C. Treviranus, **"Bemerkungen über die Führung von botanischen Gärten, welche zum öffentlichen Unterricht bestimmt sind"**, Georgi, Bonn, pp. 39, 1848.

H. J. Venema, **"Arboreta, hun Geschiedenis, Inrichting en Functie"**, Nederl. Boschbouwtijdschrift, Nov. 1939, pp. 453-469.

W. H. de Vriese, **"Kruidtuinen en Herbariën in betrekking tot Onderwijs en Wetenschap"**, Leiden, 1849.

Washington, D. C.—Many general references will be found in the catalogue of the U. S. Dept. of Agriculture, they are followed by hundreds of references to this library's rich holdings on past and existing botanical gardens, arboretums and related institutions.

A. te Wechel, **"Aan welke eischen moet een Boschbouwarboretum voldoen?"**, Nederl. Boschbouwtijdschrift 11:329, 1938.

R. v. Wettstein, **"Ueber die Aufgaben der botanischen Universitätsgärten"**, Verh. Zool.-Bot. Ges. Wien, vol. 40, 1890.

E. de Wildeman, **"Jardins Botaniques d'État et leur Mission"**, Nat. Belg. et Jardin Agr. 9(4) :50-58, 1930.

J. C. Willis, **"Tropical Botanic Gardens"**, Ann. Jard. bot. Buitenzorg, Sér. 2, Suppl. 3, p. 226-234, 1910.

D. Wyman, **"The Park Arboretum"**, Parks & Recreation, pp. 96-99, Nov. 1939.

D. Wyman, **"The Naming of Horticultural Varieties"**, Arnoldia Vol. 3, No. 2, 1943.

D. Wyman, **"The Park Arboretum—How to Establish One as a Living War Memorial"**, Arnoldia 5 (5/7) :25-48, 1945.

C. J. Zufall, **"The Educational Value of a Medicinal Plant Garden"**, Jour. Amer. Pharm. Assoc. 14:26-28, 1925.

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► **A complete list, alphabetical by authors (or editors), of all Chronica Botanica Co. publications, including those which are in press.** — Nearly all these publications (as clearly indicated under each title) belong to one of our three monograph series, Chronica Botanica, 'A New Series of Plant Science Books', and Annales Cryptogamici et Phytopathologici. For check lists of volumes of the latter two series by numbers see p. iv. For information and terms of subscription to Chronica Botanica see p. iv (in front matter).

Prices subject to change without notice.

► **GOETHE'S BOTANY** *by* **Agnes Arber**, D.Sc., author of 'Herbals', etc. — The booklet centres in a new translation of Goethe's *Versuch die Metamorphose der Pflanzen zu erklären* (1790); notes on previous versions are added. The present translation is preceded by an introductory study, dealing not only with this treatise, but also with Goethe's more fragmentary later work, and with his botanical life in general. A reassessment of his position in the history of biology has seemed desirable, in view of the contradictory opinions of recent writers, some of whom altogether discount the value of his scientific work, whilst others regard it as of the first importance. In the present study some attempt is made to appraise his contribution, and especially to see it in perspective, and in relation to the mystical belief in the unity of all things which pervades his thought. — *Chronica Botanica, Vol. 10, No. 2* (*1946*); Sup. roy. oct., 64 pp., 10 pl. and illustr.................. **$2.00**

Contents: Introduction. A note on translations. Translation. Appendix: The fragment "Die Natur" (prefatory notes, original text, and translation).

There are several illustrations, some of them from little-known sources, including a large two-page reproduction of Goethe's "Höhen der alten und neuen Welt bildlich verglichen".

As an appendix, the original text of the prose poem, *Die Natur,* is reproduced, and followed by a new translation. This ode has been, in general, attributed to Goethe, but reasons are given for the translator's view that it was not written by Goethe, but by his friend Tobler. It has, nevertheless, its own bearing upon the course of Goethe's scientific life.

► **FOREST TREE SEED OF THE NORTH TEMPERATE REGIONS** *by* **H. I. Baldwin**, Ph.D. (N. Hampshire Forestry Dept.). — This is the first book dealing exclusively with tree seed to be published in English. It attempts to give a brief introduction to the life history and behavior of tree seeds and the problems encountered by the forester and nurseryman in collecting, extracting, storing and preparing seeds for sowing. The enlarged reforestation and soil conservation programs in many lands during recent years make a specialized treatise on tree seed highly appropriate. Growing recognition of the significance of seed source for the success of plantings is emphasized throughout the book. An especial feature is a glossary of tree seed terms, many of them with equivalents in other languages. Selected references are given after each chapter. — *A New Series of Pl. Sci. Books, Vol. 8* (*1942*); Sup. roy. oct., buckram, 240 pp. 28 illustr.............. **$5.00**

Contents: Structure and development. Seed production. The importance of seed source or provenance. Seed collection. Extraction. Cleaning and treatment. Storage and longevity. Insects, diseases and other enemies. Germination. Internal and external factors affecting germination. Chemical aspects. Seed stimulation. Different kinds of tests. Purity analysis. Determination of origin. Testing viability without germination. Testing of germination. Seed testing stations and certification. Research. Glossary. Indices.

The material presented is critically examined, well documented, and there are fairly extensive lists of references to literature. Much of the discussion on harvesting, storage, and germination pertains with equal validity to many types of plants, so that the book has a wide field of interest and usefulness beyond the more immediate limits of species of trees (Kraus *in* Bot. Gazette).

The author began his self-appointed task fifteen years ago, and has tabulated and classified every bit of information he could come across bearing on forest tree seed, whether published in the literature, or his own field and laboratory observations, or correspondence beginning with a long questionnaire issued to some 300 experts . . . There can be few so well qualified to make a critical review as the author, who has taken an active part in forestry in New England since 1924, having been primarily engaged on research work . . . The historical aspect is kept in mind and adds to the general interest, and an extensive bibliography is appended to each chapter — the references must total up to approximately one thousand and occupy twenty-four pages in all. Diagrammatic figures are given whenever helpful as for germinators, seed extraction plant, etc. . . . It can be said with certainty that every forester will learn from this book a number of useful facts of which he has hitherto been unaware, and that every forest library and research station should procure a copy (Champion *in* Emp. For. J.).

The work will be indispensable to research workers in the field of tree seed and very useful to practical foresters and members of the seed trade. It is not a handbook of tree seed, giving cut and dried information about individual species, but a reference book and a guide, not only to existing knowledge but also to the direction in which that knowledge should be extended in the future (Thomson *in* Nature).

► **PLANT VIRUSES AND VIRUS DISEASES** *by* **F. C. Bawden**, Ph.D. (Rothamsted Experimental Station. — *Second entirely revised and modernized edition* with many new illustrations. No chapter remains unchanged, and more than half have been completely rewritten. Recent advances in all branches of the subject are described and correlated. Techniques new to botanists are discussed, special attention being given to work on the chemical, physico-chemical and serological properties of purified virus preparations. Modern concepts on the nature, origin, size and multiplication of viruses are critically reviewed. — *A New Series of Pl. Sci. Bks., Vol. 13* (*1943*); Sup. roy. oct. buckram, 294 pp., 48 illustr. (*almost out of print; third, entirely revised edition in preparation*) **$5.00**

Contents: Symptomatology. Transmission. Relationships between viruses and insect vectors. Virus strains, mutation, and acquired immunity. Serological reactions. Methods of purification. Properties of purified virus preparations. Optical properties of purified virus preparations. Inactivation of viruses. The sizes of virus particles. Physiology of virus-diseased plants. The classification of viruses. Control. Origin and multiplication of viruses.

In recent years students of plant viruses have been joined by workers in subjects which at first sight seem to have little connection with plant pathology. Biochemists, physical chemists, serologists, statisticians and X-ray specialists have all taken a hand in the game and the ordinary biologist finds himself somewhat bewildered by these specialists each talking a jargon of his own. One welcomes therefore the present volume which gives a lucid explanation of much of this unfamiliar technique . . . written in an interesting and readable style and the subject is presented in a coherent and consecutive manner and is not a mere statement of unrelated facts (K. M. Smith *in* J. Path. Bact.).

The high reputation of the author as a pioneer in the investigation of the nature and properties of plant viruses is a guarantee of the accuracy of the subject matter of this book. The material has been presented in a manner which makes its reading easy and pleasant. The many excellent plates and extensive bibliography add to the value of what must be regarded as an outstanding work (Best *in* The Australian Journal of Science).

► A SOURCE BOOK OF AGRICULTURAL CHEMISTRY *by* C. A. Browne, Ph.D., Sc.D. (U.S. Dept. of Agriculture). — A History of Developments in the Application of Chemistry to the Theory and Practice of Agriculture from the Time of Democritus to the Period of Liebig. — *Chronica Botanica, Vol. 8, No. 1 (1944)*; Sup. roy. oct., 290 pp., 1 plate, 32 illustr. $5.00

Contents: Agricultural chemistry in ancient times. Agricultural chemistry in the alchemical and iatrochemical periods. Agricultural chemistry in the time of the early Royal Society. Agricultural chemistry in the early phlogiston period. Agricultural chemistry in the late phlogiston period. Agricultural chemistry during the chemical revolution. Agricultural chemistry at the beginning of the modern period.

This is one of the rare books the extraordinary scope and meaning of which have not been and apparently could not be covered adequately by title. It is far more than "A Source Book of Agricultural Chemistry." It is a documentary history of the change of chemical concepts within agriculture, and it touches in its travel from Graeco-Roman antiquity to the period initiated by Justus von Liebig, an almost incredible variety of subjects and ideas. Beneath the chapters forming this book and the judgments contained in it, lies an enormous amount of searching, reading, reflection and discernment. The method employed by Charles A. Browne is a bio-bibliographical one. Brief but pertinent biographies of the authors quoted are followed by extracts from their writings, and both authors and quotations are presented in relation to the world in which they lived and to posterity, offering much essential information for every one interested in the development of science and of human thought (Urdang *in* J. Am. Pharm. Assoc.).

Perhaps few general histories of science come sufficiently close to historical grassroots to actually be in a position of demonstrating the true educational and intellectual value of science history. The volume under review accomplishes precisely that to a degree seldom equalled (Graubard *in* The Sci. Monthly).

El Dr. Browne, del Departamento de Agricultura de Estados Unidos, nos describe, a base de fuentes originales, los comienzos y el lento pero gradual desarrollo de los principios fundamentales de la Química, de aplicación a la Agricultura, hasta el año 1840. Siendo como es un "libro de fuentes" abundan en él las citas de los autores que, a través de los tiempos, más se han destacado en esta ciencia . . . Para los que no se hallan en condiciones de acudir a fas fuentes originales, el trabajo que nos ofrece el Dr. Browne es de indispensable manejo. Para todo hombre de ciencia este volumen contiene un caudal considerable de datos y valiosa información. El libro está excelentemente presentado como es la regla en las publicaciones que dirige el Dr. Verdoorn (María de la Luz Nápoles H. *in* Ciencia).

► THOMAS JEFFERSON AND THE SCIENTIFIC TRENDS OF HIS TIME *by* C. A. Browne, Ph.D., Sc.D. (U.S. Dept. of Agriculture). — A scholarly essay, by the Nestor of American Agricultural Chemists, on Thomas Jefferson's position in the world of science, his "Notes on the State of Virginia", his scientific services to the new republic of the United States, his agricultural and educational work, and some of the eminent contemporaries who knew Jefferson personally and exchanged with him letters that throw much light on the scientific movements of the time. — *Chronica Botanica, Vol. 8, No. 3 (1944)*; Sup. roy. oct., 64 pp., illustrated with 17 contemporary drawings, maps, and facsimiles...... $1.25

This volume is one of the finest tributes to Thomas Jefferson which has recently been published to commemorate the 200th anniversary of his birth. It is handsomely illustrated with maps, facsimiles, a wood cut of Monticello, an old wood engraving of the University of Virginia, a diagram of the Monticello Garden, a silhouette of Jefferson, a drawing of the plant *Jeffersonia* Barton, and other cuts . . . This timely, scholarly, carefully documented, and beautifully written account of the labors of Jefferson and his contemporaries is a valuable contribution to the history of science in America (Weeks *in* J. of Chem. Educ.).

The author draws easily on his wide knowledge of the history of science to give the reader a clear picture of Jefferson's views in relation to those of the distinguished scientists and agriculturists of his time. In fact, he accomplishes the double task of evaluating the period as well as the rôle Jefferson played in it. Any reader interested in science, in agriculture, in Jefferson, or in the formative period of the United States will certainly find this little book of great interest (Kellogg *in* Journ. Am. Soc. of Agronomy).

► THE CEREAL RUSTS AS EXEMPLIFIED BY THE LEAF RUST OF WHEAT *by* K. Starr Chester, Ph.D. (Oklahoma Agricultural College). — At a time when the world's wheatfields are being anxiously eyed by its hungry populations, the rusts, the most destructive diseases of wheat, assume great social as well as agricultural importance. The principles developed in this monographic treatment of wheat leaf rust apply to cereal rusts in general, many of them to plant diseases in general. The book is based on the world literature, particularly the Russian and on the author's researches in this field. Particular emphasis is given to the effect of environment on rust and host plant, host-parasite relationships, rust dissemination, rust specialization, and rust control. — *Ann. Crypt. et Phytop., Vol. 4 (1946)*; Sup. roy. oct., buckram, 270 pp., illustrated $5.00

Contents: Introduction; names and history of the disease. Origin, distribution, and economic importance. Effect of the rust on the host plant and its yields. Suscepts. Symptomatology. Etiology. Physiologic specialization. Factors affecting rust survival and development. Rust dissemination; annual cycles; epiphytotics. Natural, regulatory, and cultural rust control. Rust control by the use of fungicides. Control by rust resistance.

► THE FIG *by* Ira J. Condit, Ph.D. (Univ. of California). — A complete account of the common fig based on the author's investigations of 30 years in California and of personal studies in the principal fig-growing districts of the Old World. It is the first real book on the fig to be published in English. Only two other books, one in Spanish and one in Italian, are known. The fig in history and folklore and references to it in literature are features of the first chapter. Other chapters deal with history and distribution, botany, caprification, breeding, varieties, culture, handling the crop both fresh and dried, fig products, and marketing. An extensive bibliography to literature both ancient and modern, provides a source of information regarding this well known subtropical fruit. — *A New Series of Pl. Sci. Books, Vol. 20;* Sup. roy. oct., buckram, ca. 240 pp., illustrated, *in press, ready shortly* .... *ca.* $5.00

Contents: The fig in song and story. History and distribution. Systematic botany. General botany. Caprification. Fig breeding. Fruit characters. Fig varieties. Some fig districts of the Old World. Other fig districts. Climatology. Propagation. Fig culture. The fresh fig crop. The dried fig crop. Fig products. Chemistry and food value. Economics and marketing. Diseases. Insects and other pests. Bibliography.

► ARBORETUMS, THEIR AIMS AND SCOPE *by* Gordon D. Cooper, B.S.A., Fellow, Am. Soc. of Landscape Architects (Cleveland, O.). — The author, who has gone to great efforts to study the organization and growth of arboretums in the U.S.A., presents a detailed analysis of all possible problems connected with the establishment and development of an arboretum, with special reference to North American conditions. There are two interesting supplements: (1) a historical account of arboretums, on an international basis, by L. H. Baas Becking, and (2) an annotated list of the principal arboretums of North America. — *Chronica Botanica, Vol. 11, No. 2 (tent)*; Sup. roy. oct., ca. 120 pp., illustrated, *in press, ready in the course of 1947* .... *ca.* $3.00

Contents: Botanical institutions. Purposes of arboretums. Need for arboretums. History of arboretums. Functions of arboretums. Requirements for a modern arboretum. Selection of sites for arboretums. Contents of arboretums. General design of arboretums. Special design. Steps in the making of an arboretum. Supplements (*cf. supra*).

► **GENERA FILICUM — THE GENERA OF FERNS** *by* **Edwin Bingham Copeland**, Ph.D. (Univ. of California). — An account of the genera and families of pteridophytes filling the long-felt need for a modern account of the ferns and fern allies of the world. — *Ann. Crypt. et Phytop., Vol. 5;* Sup. roy. oct., buckram, ca. 300 pp., 10 plates, *in press, ready very shortly* $6.00

From the foreword: The first reason for the preparation and publication of this book is the fact that progress in our understanding of systematic pteridology during the past half-century has been so great that no existing general work on the subject retains much more than a historical value. — The second is that it beseems the author of a large number of papers dealing with details and with parts of a general subject to digest and summarize his work, and to present it properly integrated with that of his predecessors and contemporaries . . . This may be something of wider significance than a treatise on the genera of ferns. It is the author's belief that pteridology has returned to its position of a century ago, as the best developed field of systematic botany; that it is possible to demonstrate the phylogeny of fern genera more clearly and convincingly than that of any other similarly great group of plants can be presented.

The breaking up of the huge and unnatural genera *Dryopteris* and *Polypodium* into their natural components has involved the formation of some six hundred new specific combinations, made here to facilitate proper filing in herbaria. The work is well supplied with keys to the genera, with which it is believed that any fern in the world can be properly identified.

► **PEAT — THE FORMATION, COMPOSITION, PROPERTIES AND UTILIZATION OF THE PEAT DEPOSITS OF THE WORLD** *by* **A. P. Dachnowski Stokes**, Ph.D. (U.S. Dept. of Agriculture). — The author's own research and experience of many years give him the background necessary to a better understanding of peat deposits throughout the world, their materials, and the factors affecting their utilization. The book summarizes basic information and shows how the progress in peat investigations has led to specialization of research in various lines of scientific study. The more important results so far achieved by government agencies, experiment stations, universities, and other research institutions are discussed, together with their wide implication to agriculture, industry, and technology. — *A New Series of Pl. Sci. Bks., Vol. 24;* Roy. oct., buckram, ca. 220 pp., illustrated, *in press*....*ca.* $4.75

Contents: Introduction. Main groups and types of peat, their botanical composition and uses. Physical properties of different kinds of peat. Chemical composition of various peat materials. Thermochemistry of peats. Microbiological activity in the formation and decomposition of peat materials. Biochemical activity in peat composts. Formation and stratification of peat deposits. Factors in the classification of peat deposits. Geographical distribution of peat deposits. Correlations. Bibliography.

An interesting feature of the book will be a well illustrated chapter on *Peat Deposits of the Southern Hemisphere* contributed by Lucy Cranwell Smith, M.A., F.L.S., F.R.S.N.Z., formerly botanist at Auckland Institute and Museum, Auckland, New Zealand.

► **AN INTRODUCTION TO POLLEN ANALYSIS** *by* **G. Erdtman**, Fil.Dr. (Stockholm). *Foreword by* **Roger P. Wodehouse**. — The first and only comprehensive reference work on the methodology and applications of pollen analysis. — *A New Series of Pl. Sci. Bks., Vol. 12 (1943)*; Sup. roy. oct., buckram, 239 pp., 46 plates and illustr.............$5.00

From the contents: Historical. Chemistry of peat. Pollen preparations. Preparation of fossil pollen-bearing material. Pollen and spore morphology. Graphic presentation. Correlation. Output and dissemination of pollen. Surface samples. Pollen flora of peat samples. Investigations in different countries. Tertiary deposits. Honey and drugs.

It was G. Erdtman, a Swede, who in the nineteen-twenties introduced British and American scientific men to the principles and technique of pollen analysis, a new method of geological inquiry which had recently been developed in Scandinavia, particularly by the energy and insight of L. von Post. The succeeding years have seen a very great extension of the applications of pollen analysis. Not only has it been used in countries in all parts of the world to elucidate their forest history, and thence the drift of former climatic conditions, but also it has been shown to afford the means of solving an unexpectedly wide range of problems . . . It has long been recognized that dating of prehistoric objects and structures found in lake or bog deposits is often possible by reference to the geochronological scale afforded by the regular drift of forest history. Similarly, the course of relative movement of land- and sea-level may be effectively dated, and eustatic effects distinguished from isostatic. More recently, it has become apparent that not only is the former distribution of natural plant communities reflected by pollen analyses, so that the conditions of salt-marsh, lake, fen, forest and bog may be accurately recognized in buried layers, but also, as Iverson has shown, the influence of prehistoric man in modifying natural communities may be detected, together with the origin of the new anthropogenous vegetation he has created . . . Hitherto no text-book of pollen analysis has been available, and we warmly welcome, therefore, the appearance of the "Introduction to Pollen Analysis" by Dr. Erdtman. He has himself in the last twenty years contributed important results in the field of pollen analysis. He has developed a technique of preparation by chlorination and acid-hydrolysis which very greatly simplifies counting of grains in materials poor in pollen: he has sharpened the technique of critical recognition of species by their pollen morphology, and he has contributed much to the knowledge of long-distance flight of pollen. In this book these matters are given adequate treatment, together with such related topics as the analysis of pollen in honey as a basis for determination of the country and season of its origin, and the geological use of spore-counts in coal seams (Goodwin *in* Nature).

► **A CATALOGUE OF INSECTICIDES AND FUNGICIDES** *by* **Donald E. H. Frear**, Ph.D. (Pennsylvania State College). — This compilation, prepared by the author of "Chemistry of Insecticides and Fungicides" lists over 10,000 chemicals, plant species, and miscellaneous materials which have been tested for the control of insects and plant diseases. Each tested material is listed separately, with its chemical name, synonyms, and complete formula. In addition, the results of the insect and fungus tests, and one or more literature citations are given for each material. This compilation was prepared after an exhaustive examination of journals, textbooks, and foreign and domestic patents covering the field, and contains considerable heretofore unpublished information contributed by co-operating industrial and private testing laboratories. By eliminating laborious literature and patent searches, this catalogue will prove invaluable to all research workers in entomology, plant pathology, and agricultural chemistry. In addition, it will be of interest to students, executives and others concerned with pest-control materials. — *Ann. Crypt. et Phytop., Vols. 7 and 8;* Sup. roy. oct., ca. 500 pp., *in press, ready autumn 1947*....*ca.* $12.00

Volume I: Chemical insecticides. Condensation products. Miscellaneous insecticides. Patent index by countries of origin and by number. Author index and literature references.

Volume II: Chemical fungicides. Condensation products. Plants tested as fungicides. Miscellaneous fungicides. Plants tested as insecticides. Patent index by countries of origin and by number. Author index and literature references.

► **THE GENUS BAZZANIA IN CENTRAL AND SOUTH AMERICA** *by* **Margaret Fulford**, Ph.D. (Univ. of Cincinnati). — A critical monograph of one of the most interesting genera of liverworts, the first complete, modern revision of the neotropical species of a large and difficult genus of hepaticae, since Stephani produced his confusing *Species Hepaticarum*. — *Ann. Crypt. et Phytop., Vol. 3 (1946)*; Sup. roy. oct., 176 pp., numerous illustr.......$5.00

Contents: Introduction and history. Characteristics of the genus *Bazzania*. Description of the American species. Subgenus *Bidentatae*. Subgenus *Tridentatae*. Excluded species. Distribution. Literature.

► **ROOT DISEASE FUNGI** *by* **S. D. Garrett**, M.A., D.I. (Rothamsted Experimental Station). — The first book dealing exclusively with this important group of fungi. Principles of root disease control are fully expounded for the benefit of all practising plant pathologists. Control measures are classified separately for field, plantation and glasshouse crops. A special feature is the full treatment of root disease control in tropical and subtropical crops, but no important root disease of any crop has been omitted. Of particular interest to soil microbiologists are the chapters on biology and evolution of the root-infecting fungi. — *Ann. Crypt. et Phyt., Vol. 1 (1944)*; Roy. oct., buckram, 177 pp., 9 illustr... **$4.50**

Contents: Parasitic specialisation in the root-infecting fungi. Parasitic activity of the root-infecting fungi. Influence of soil temperature upon parasitic activity. Influence of soil moisture content, texture, and reaction upon parasitic activity. Influence of soil organic content and concentration of plant nutrients upon parasitic activity. Saprophytic activity of the root-infecting fungi. Dormancy of the root-infecting fungi. Control of root disease in field crops: crop rotation. Control of root disease in field crops: plant sanitation. Control of root disease in field crops: disease control under the growing crop. Control of root disease in plantation crops: on virgin areas. Control of root disease in plantation crops: in mature plantations and on replanted areas. Control of root disease in plantation crops: special problems. Control of root disease in glasshouse crops. Bibliography.

The appearance of this book marks the first volume of Annales Cryptogamici et Phytopathologici, edited by Frans Verdoorn. The author stresses the relationships between the inciting agents of these diseases and their habitats — the soil. The book is an interesting ecological study of an important group of causal agents within the larger field of root diseases of plants . . . It is well written and the illustrations are excellent (Link *in* The Bot. Gazette).

This book is of more than usual interest to those having to do with soil management in relation to crop production in that it deals with one of the more obscure phases of this problem about which there is great need for more exact information than has been contained in the usual classroom textbook (Soil Science).

An important purpose of the author is to emphasize the concept that the study of the root-infecting fungi can be seen as a problem in ecology. One happy result of such an approach is the discussion of a wide variety of types to illustrate the varied relations between fungi and soil. Information concerning a root-infecting fungus of such a typical temperate climate plant as wheat is often followed by a related discussion on cotton, banana or rubber root-infecting fungi, parasites whose optimal habitat requirements are obviously widely different. Since few are likely to have had actual experience with such a diversity of types, it is likely that many will find this unusual blend of information stimulating (Adam *in* Austr. J. of Science).

A copy of Garrett's Root Disease Fungi was included in the highly selective exhibit, organized in San Francisco at the occasion of the United Nations Conference, of 120 technically outstanding books, recently produced in the U.S.A.

► **LECTURES ON THE INORGANIC NUTRITION OF PLANTS** *by* **D. R. Hoagland**, A.M. (Univ. of California). — This series of lectures, based on the *Prather Lectures at Harvard University,* delivered by the author in the spring of 1942, outlines a number of important problems of plant nutrition, with a very considerable amount of illustrative material derived from extensive researches at the Univ. of California. Scientific aspects of certain soil-plant interrelations, nutrient absorption and utilization, and artificial culture methods are primarily discussed. Trends of research in plant nutrition and opportunities for further exploration are stressed. — *A New Series of Pl. Sci. Bks., Vol. 14 (1944)*; Roy. oct., buckram, 226 pp., numerous ill., tables and plates **$4.00**

Contents: A survey of problems. Micronutrient chemical elements and plant growth. The absorption and accumulation of salts. Upward movement and distribution of inorganic solutes. The growth of plants in artificial media. Some biochemical problems associated with salt absorption. Aspects of the potassium nutrition of plants as illustrating problems of the system, soil-plant-atmosphere.

The discussions are based upon work done in many laboratories, but with emphasis upon work done in the Div. of Plant Nutrition of the Univ. of California, where Dr. Hoagland's genius has found its expression in a long series of distinguished contributions. He and his coworkers have been leaders in this field for many years, and it is a valuable service to plant physiologists to have the field presented by one so familiar with the techniques and the historical development of the subject of inorganic nutrition of plants. It is excellent in bringing the various phases of nutrition into a true perspective, and giving in compact space the essential ideas and philosophy of this region of plant physiology. — It is so well done that it is hoped that every member of *the American Society of Plant Physiology* will want a personal copy of it (Plant Physiology).

Aunque el Prof. Hoagland, primera autoridad sobre estos estudios en el Continente americano, no considera esta compilación de conferencias, ni como monografía ni como libro de texto, estimamos que es la mejor exposición actual, en lengua inglesa, sobre nutrición mineral de los vegetales, principalmente de los superiores, libro indispensable para el fisiólogo y también para el agrónomo que se interese por la fertilización de los suelos y el alimento de las plantas de cultivo (M. Castañeda *in* Ciencia).

► **SCIENCE AND SCIENTISTS IN THE NETHERLANDS INDIES** *edited by* **Pieter Honig**, Ph.D. and **Frans Verdoorn**, Ph.D. — A review of research and exploration in the Neth. Indies. Prepared under the auspices of the Board for the Netherlands Indies, Surinam and Curaçao. — *Natuurwet. Tijdschrift voor Ned.-Indië, Vol. 102, Special Supplement (1945)*; Sup. roy. oct., cloth, xxiv + 491 double column pp., 134 pl. and text illustr............. **$4.00**

► **FUNGICIDES AND THEIR ACTION** *by* **J. G. Horsfall**, Ph.D. (Connecticut Agric. Experiment Station). — An examination of the physics and chemistry of the mechanisms by which fungicides control plant diseases. Pertinent data are reviewed and critically discussed in the light of a relatively new tool for assay; namely, dosage-response. An analysis is given of the problem of deposition, coverage and tenacity as factors in protection. A discussion is also given of the factors in artificial immunization and chemotherapy, synergism, and modes of toxic action, for copper and sulphur, fungicides. The book ends with two chapters on the new organic fungicides and phytotoxicity. — *Ann. Crypt. et Phyt., Vol. 2 (1945)*; Roy. oct., buckram, 239 pp., 19 illustr........... **$5.00**

Contents: Historical introduction. Some general concepts. Laboratory assay. Some problems of data assessment. Principles of chemical protection. Deposition. Coverage of single surfaces. Coverage of multiple surfaces. Tenacity. Artificial immunization and chemotherapy. Action of copper. Action of sulfur. Action of organic nitrogen compounds. Action of other organic compounds. Antagonism and synergism. Phytotoxicity.

The general theme might be stated as an analysis of (1) the inherent toxicity and (2) the availability of fungicides as a whole in somewhat the same way that a single compound might be evaluated with respect to these two main criteria. This can be done for one compound by determining the dosage-response curve, the inherent toxicity being indicated by the slope, and the availability by the position of LD 50. "Availability" in this connection is defined as the liberation of the toxicant from the protectant and its absorption by the fungus: it is a profound subject in itself. Of course, neither the method nor the results of the dosage-response curve analysis can be literally applied to the evaluation of fungicidal action in the abstract, but the analogy illustrates the basic objectives of the author in this work. It is not a handbook of spraying nor a manual of toxicology. It is probably the first book in this field that wholly eschews these more tangible aspects of fungicides in favor of a direct attack upon the problem of the physical and chemical principles that determine fungicidal action (Weiss *in* Chemical and Engineering News).

This book, by a leading authority on fungicides, is the first in English exclusively on this important subject. It is especially welcome to plant pathologists for whom the principal treaties on fungicides have been in books devoted mainly to insecticides, with fungicides treated as a

secondary, but related, subject. HORSFALL has devoted most of the past fifteen years to intensive research on fungicides, and he and his associates at Geneva, New York, and at New Haven, Connecticut, have contributed many of the noteworthy advances in the knowledge of fungicides during that period. . . . Some topics, such as chemotherapy and organic nitrogen fungicides, refer mostly to work in the past ten years and much of the information on toxicity of organic compounds consists of previously unpublished data of the writer and associates. The various basic methods by which a parasitic organism may be rendered innocuous by chemicals are described and classified with examples. The treatment of bio-assay by means of straight-line dosage response curves is one of several unique features of the book. In addition to reviewing data previously presented in this way the writer has recalculated data in the literature in order to present it in this illuminating manner. There is an excellent treatment of toxicity and its relation to the molecular structure of organic compounds (YARWOOD *in* SCIENCE).

► **LUTHER BURBANK, A VICTIM OF HERO WORSHIP** *by* **W. L. Howard**, Ph.D. (Univ. of California). — Some twelve years ago the writer undertook the preparation of an authentic list of all fruits, flowers, vegetables, and other things, the late LUTHER BURBANK introduced during the fifty years of his working life, and where possible, giving some idea of their worth. The task was prolonged because BURBANK kept no systematic record of what he produced. His advertising literature was scattered to the four winds. The author personally examined libraries and private collections from Coast to Coast. To determine the value of many of BURBANK's productions it was necessary to contact dealers all over the world. — A by-product of the studies was a mass of information, much of it new, about the man himself, which answered many puzzling questions. — *Chronica Botanica, Vol. 9, No. 5/6 (1945)*; Sup. roy. oct., 208 pp., illustrated by photographs and facsimiles.......$3.75

Contents: The background. The man. The nurseryman. The scientist. The egoist. The mentor of youth. The unfortunate. The pariah (of scientists). The disappointed. The world character. The individualist. Ethics. Religion. Foray into science — the Carnegie grant. Admirers. Detractors. BURBANK's place in the hall of fame. Summary of BURBANK's productions. Aftermath. The BURBANK family.

In 21 chapters the leading events of BURBANK's life are discussed objectively, but fairly, frankly and without embellishment. This is, without doubt, the first true and complete picture of this controversial character, which labored for 50 years to improve economic plants and which produced and sent out over 800 new varieties of fruits, flowers and vegetables, many of them of permanent value.

. . . The conclusion to which he came was that BURBANK was unwisely promoted by exploiters, that the heedless and ill-advised claims of hero-worshipers damaged his reputation with scientists, but that California and the world at large have profited immeasurably by the new fruits BURBANK originated. And in this carefully written and documented study, Mr. HOWARD puts forward his reasons for these conclusions in full and complete detail (JACKSON *in* SAN FRANCISCO CHRONICLE).

► **VEGETABLE GUMS AND RESINS** *by* **F. N. Howes**, D.Sc. (Kew). — In modern industry the use of large quantities of both resins and gums continues to increase. In recent years many kinds, which are not dealt with in older works, have become of commercial importance. Particular attention has been paid to these recent developments in this international review of the gums and resins which are of commercial importance or which are of some special interest. The author is a member of the staff of the Museum of Economic Botany, Kew, and of the Imperial Institute Consultative Committee on Gums and Resins. — *A New Series of Pl. Sci. Bks., Vol 25;* Sup. roy. oct,, buckram, ca. 240 pp., illustrated. *in press, ready shortly* ....*ca.* $4.75

Contents: Gums: Properties and uses of gums. Gum arabic and other acacia gums. Gum tragacanth and similar gums. Some well known or much used Asiatic gums. Gums of the New World. Miscellaneous and little known gums. — Resins: Properties and uses of resins. Copals. Dammars. Kauri resin. Soft varnish resins. Rosin or colophony. Natural lacquers. Shellac. Medicinal and other resins. Bibliography.

► **BIOLOGICAL FIELD STATIONS OF THE WORLD** *by* **Homer A. Jack**, Ph.D. — An extensive and critical study of the aims, scope and organization of the biological field stations of the world. A unique account of great practical, as well as historical interest. Based on the results of years of travel and world wide systematic enquiries. — *Chronica Botanica, Vol. 9, No. 1 (1945)*; Sup. roy. oct., 74 pp., illustrated $2.50

From the contents: Purpose of biological stations. History. Location. Administration. Equipment. Living Facilities. Instruction. Educational Philosophy. Research. Annotated list of biological stations covering the entire world, with much practical information, publications, references, etc.

This paper is a very welcome addition to the literature on an important aspect of education and research. Field stations seem destined to expand greatly as the application of scientific methods is extended to the biological and ecological resources of the world and as their utilization comes under intelligent supervision . . . About half of this paper on field stations is devoted to a discussion of the broad general aspects of the subject, including such phases as their purposes, history, administration, equipment, facilities, instruction, and research plans. This appears to be the most comprehensive discussion of their functions that has been produced. Every phase of their work is discussed briefly, including condensed references to the literature . . . The remaining half of the paper is devoted to the 1939-1940 status (qualified by war conditions) of these stations, including a condensed descriptive directory of the field stations or laboratories arranged alphabetically in 59 political units, beginning with Alaska and ending with Yugoslavia. When available, a brief sketch is given of each station, and reference is made to official and other publications. The author has visited 79 of these in 18 countries out of the total of 271 listed (ADAMS *in* THE SCIENTIFIC MONTHLY).

Biological stations are perhaps the most important intellectual catalysts for biological research. The informality of work under simple conditions, the mixing of experienced workers and young students, the holiday feeling of mealtimes and discussions, all combine to make the atmosphere exhilarating and to generate ideas . . .. It is useful to have assembled in one place information on the history, administration, facilities and even 'educational philosophy', of biological stations. The most useful part of the work is a directory of 271 biological stations in all parts of the world (ASHBY *in* NATURE).

► **PLANT EMBRYOLOGY, Comparative Embryogeny of Spermatophyta** *by* **Donald A. Johansen**, Ph.D., author of 'Plant Microtechnique'. — This is the first book to be prepared that deals exclusively with embryology s. s. The gymnospermous phyla are first discussed, following which the flowering plants are exhaustively considered. The laws of embryogeny are described in detail and illustrative examples are cited. These laws form the basis for a simple, logical classification of the various types of embryogeny prevalent among angiosperms. A systematic treatment of all species of which the development has been sufficiently described in the literature is presented, with each species classified as accurately as possible. Adventitious embryogeny and polyembryony are considered in separate chapters and the various manifestations of each have also been classified. — *A New Series of Pl. Sci. Bks., Vol. 23;* Sup. roy. oct., buckram, ca. 300 pp., with numerous illustrations, *in press, ready shortly,* *ca.* $6.00

Contents: Cycadophyta: Cycadaceae. Ginkgophyta: Ginkgoaceae. Coniferophyta: Pinaceae, Araucariaceae, Sciadopitaceae, Taxodiaceae, Cupressaceae, Saxegothaeaceae, Podocarpaceae, Pherosphaeraceae, Cephalotaxaceae, Taxaceae. Ephedrophyta: Ephedraceae, Gnetaceae, Welwitschiaceae. Anthophyta: general considerations, types and variations, special and comparative embryology, adventitious embryogeny, polyembryony. Glossary. Indices.

► MYCOTROPHY IN PLANTS *by* **Arthur P. Kelley**, Ph.D. (Landenberg Labs., Pa.).—This book provides Botany for the first time with a comprehensive survey of mycotrophic processes. Instead of plants being provided with nutriment by a root-hair mechanism, many plants in nature—in all the major groups of plant taxonomy—live in intimate association with fungi that bring to them much of the raw materials upon which they live. This association is naturally accompanied by structural peculiarities which are described; and occurs under ecological circumstances that are briefly treated. Many hypotheses to account for this strange mode of plant nutrition have been advanced, and these are reviewed; while in the final chapter the author presents evidence to show that mycotrophy is a mechanical process conditioned by the ordinary laws of biology.—*A New Series of Pl. Sci. Bks., Vol. 19;* Roy. oct., buckram, ca. 240 pp., illustr., *in press, ready shortly*............................*ca.* **$4.75**

Contents: Historical introduction. Systematic occurrence of mycotrophic plants. The fungal endophytes. Fossil mycotrophs. Geographical distribution. Mycotrophic plants and their environment. Mycothalli and mycorrhizomes. Mycodomatia. Structure of mycorrhizae. Obligate symbiosis. Theories of mycotrophy. Mycotrophic phagocytosis.

► A DICTIONARY OF GENETICS *by* **R. L. Knight**, Ph.D. (Khartoum).—A dictionary of modern as well as older terms used in genetics and related fields as plant breeding, animal breeding, cytology and evolution.—*A New Series of Pl. Sci. Bks., Vol. 26* (tent.); Sup. roy. oct., ca. 200 pp., *in press, ready spring 1948*........................*ca.* **$4.00**

The appendices comprise (1) Useful formulae; (2) Coefficients of the terms in the expansion of $(1 + X)^n$ for values of n from 1—20; (3) 2^n and 4^n for values of n from 3 to 20; (4) Distribution of X^2; (5) Genotypes expected in Backcrosses and F_2s: (6) Percentage of homozygotes in each generation following a cross the whole progeny of which is continuously selfed; (7) Rate of elimination of donor genotype by backcrossing.

► THE CARNIVOROUS PLANTS *by* **F. E. Lloyd**, D.Sc., Emeritus Prof. Botany, McGill University.—Since the appearance of CHARLES DARWIN's "Insectivorous Plants" in 1875 no comprehensive treatise on these biologically exceedingly interesting plants has appeared. The gradual advance of our knowledge has been summarized from time to time by DRUDE, PFEFFER, ED. MORREN, HOOKER, GOEBEL and LLOYD, but a fully documented treatment was greaty needed. The illustrations are nearly all original and include numerous halftone plates, enabling the reader to visualize the forms discussed, and a large number of line drawings amplifying the text.—*A New Series of Pl. Sci. Bks., Vol. 9 (1942)*; Sup. roy. oct., buckram, 352 pp., several hundred illustrations **$6.50**

Contents: Introduction. Heliamphora. Sarracenia. Darlingtonia californica. Nepenthes. Cephalotus follicularis. Genlisea. Byblis. Drosophyllum lusitanicum. Pinguicula. Drosera. The carnivorous Fungi. Dionaea. Aldrovanda. Utricularia, Biovularia, and Polypompholyx. Indices.

It is so clearly and entertainingly written that anyone with a modicum of botanical knowledge can enjoy it and use it as a guide. Professor LLOYD's drawing and photographs are very clear and helpful, and the 38 plates incorporate hundreds of them. Production is of the high standard we have learnt to expect from Chronica Botanica. Altogether, a distinguished performance for which thanks and congratulations are due to both author and publisher (STEPHENS *in* J. So. Af. Bot.).

It is, therefore, the more commendable and welcome that finally LLOYD has completed this comprehensive authoritative, and detailed study of the carnivorous plants. Any such study which traces a function or an activity through the diverse plants possessing it is bound to have a significant influence on science, and this authoritative volume without doubt will prove to be an epoch-making one. Comprising in large part the author's own original work, yet with a masterly synthesis of all the pertinent work previously done by others, the book has a thoroughness and completeness that stamp it as outstanding. All possible aspects of the plants concerned—their taxonomy, anatomy, physiology, ecology, and relationship—are considered in detail, with authoritative knowledge derived from the writer's 13 years of enthusiatic devotion to this field, devotion that involved careful absorption of an extensive literature in several languages, and first hand study of living material on this continent, in Europe, and in more remote localities during two journeys—one to Africa, another to Africa and Australia—supplemented by extensive correspondence, by securing the cooperation of collectors and naturalists in favorable localities, and by periods of study at various botanic gardens and laboratories . . . The volume is a beautiful job of craftsmanship (QUART. REVIEW OF BIOL.).

► MERRILLEANA—A SELECTION FROM THE GENERAL WRITINGS *of* **E. D. Merrill**, D.Sc., LL.D. (Harvard University).—During his long and active life the Nestor of American Plant Taxonomists has found the time for many studies of wider general interest. Though these are often not so well known as his purely taxonomic and administrative activities, they are of great and permanent value. It seemed fitting to the Editors of Chronica Botanica to bring out on the occasion of the 70th anniversary of the birth of their distinguished co-editor, a selection, difficult as it was to make, of his more general writings. The book includes a 'Vita' and 'Bibliographia' as well as certain portraits.—*Chronica Botanica, Vol. 10, No. 3/4 (1946)*; Sup. roy. oct., 268 pp., illustrated.....**$4.00**

From the contents: The ascent of Mount Halcon. Amboina floristic problems in relation to the early work of RUMPHIUS. On the flora of Borneo. Die pflanzengeographische Scheidung von Formosa und den Philippinen. An appeal for simplified literature citations. Correlation of the indicated biological alliances of the Philippines with the geologic history of Malaysia. On LOUREIRO's 'Flora Cochinchinensis'. PALISOT DE BEAUVOIS as an overlooked American botanist. On the technique of inserting published data in the herbarium. On the significance of certain oriental plant names in relation to introduced species. Domesticated plants in relation to the diffusion of culture. Man's influence on the vegetation of Polynesia, with special reference to introduced species. Some economic aspects of taxonomy. RAFINESQUE's publication from the standpoint of world botany. In defense of the validity of WILLIAM BARTRAM's binomials. Further notes on tobacco in New Guinea.

► BIOLOGY OF PATHOGENIC FUNGI, *edited by* **Walter J. Nickerson**, Ph.D. (Wheaton College, Mass.)—A cooperative volume covering many aspects of the biology, physiology, and biochemistry of the fungi pathogenic for man. It is not a clinical manual nor a compendium on all the fungi of medical importance, but presents information and viewpoints from biology and chemistry generally bearing on these difficult forms. Aimed at the bringing together of facts and interpretations for purposes of comparison with other micro-organisms and for the furtherance of investigations of both theoretical and practical nature on the fungi pathogenic for man. The implications for disease control are stressed.—*Ann. Crypt. et Phytop., Vol. 6;* Roy. oct., buckram, ca. 250 pp., illustrated, *in press, ready 1947* ....*ca.* **$5.00**

Contents: Hopkins: Foreword; *Nickerson:* Introduction; *Emmons:* Biology of Coccidioides; *Benham:* Biology of Pityrosporum; *Lodder and de Minjer:* Biology of Pathogenic Torulopsidoideae; *Carrión and Silva:* Organisms Causing Chromoblastomycosis; *Ciferri and Redaelli:* Recent Advances of the Italian School of Mycopathology; *Wolf:* Action of Sulfonamides and Antibiotic Agents on the Pathogenic Fungi; *Martin:* Geographic Distribution of Systemic Fungus Diseases; *Williams and Nickerson:* Factors in the Nutrition of Pathogenic Fungi; *Nickerson:* Metabolic Products of the Pathogenic Fungi; *Peck:* Lipids of Fungi with special reference to the Pathogenic Fungi; *Nickerson:* Respiration of Pathogenic Fungi.

► **A LIFE OF TRAVELS** *by* **C. S. Rafinesque** (1836). *Foreword by* **E. D. Merrill.** — A complete and verbatim reprint of the extremely rare autobiography (1836) of this famous and eccentric naturalist. FITZPATRICK (1911) lists only 17 known copies in the libraries of the world. — *Chronica Botanica, Vol. 8, No. 2 (1944)*; Sup. roy. oct., 72 pp., 5 portraits.................................**$2.50**

Contents: Life and Travels till the first departure for America. Travels in North America during three years. Ten years' residence and travels in Sicily. My shipwreck and travels till 1819. Seven years' residence and travels in Kentucky. Travels from 1825 to 1830, in Virginia, Ohio, New York, etc. Travels and researches 1831/33. The sources of the R. Delaware and Susquehana. Conclusion. Travels and researches in 1834 and 1835, sources of the Schuylkill, central Alleghanies of Pennsylvania, Savings Banks, etc.

Only during the last 60 years has it dawned upon Americans, that the strange man, who died poor and lonely in Philadelphia in 1840 after having lived for 27 years among them, was not the "inspired idiot" he had been thought of and treated accordingly, but one of the greatest glories of early American science, especially in the field of botany, zoology and anthropology. It seems he was even a great innovator in business, in inventing the "coupon" system in commercial papers. In his own case at least RAFINESQUE's hopeful statement, "But time renders justice to all at last" seems to come true. This reprint of RAFINESQUE's autobiographical sketch, still the fundamental document for all biographical work on the man, is a most welcome expression of the steadily increasing interest in RAFINESQUE. In spite of displaying an overwhelming amount of travelling done and of interests developed by RAFINESQUE, this self-description is still rather an understatement of the actual truth. The same is true of the almost unbelievable amount of ill luck and bad treatment experienced by the "eccentric naturalist." This autobiography, in listing carefully the scientific contacts of RAFINESQUE, which are identified by Dr. F. W. PENNELL and the VERDOORNS in an excellent index, gives a lively picture of American science in the first half of the 19th century, — and of the state of things in Sicily between 1805 and 1815 where RAFINESQUE was confined during the blockade. As CONSTANTINE SAMUEL RAFINESQUE-SCHMALTZ was born in 1783 in Constantinople the son of a French merchant and Greek lady of German ancestry, and as he was educated in France and Italy, allusions to other countries than the United States and Sicily, the two countries he studied longest and most intensely, are not lacking (ACKERKNECHT *in* BULL. HIST. MED.).

► **A SHORT HISTORY OF THE PLANT SCIENCES** *by* **H. S. Reed,** Ph.D. (U. of California). — A readable account of the growth of the plant sciences from early times to the present. The first 'History of Botany' written by an American and published in the U.S.A. — *A New Series of Pl. Sci. Bks., Vol. 7 (1942)*; Sup. roy. oct., buckram, 323 pp., 37 illustr. **$5.50**

Contents: Introduction. Gardeners and herbalists of antiquity. The nascent period. The retrogressive period. The renascent period. The seventeenth century. The eighteenth century. Gardens and other things. Plant geography in the nineteenth century. Morphology. Cytology. The water economy of plants. The fixation of carbon. The assimilation of nitrogen. The fixation and metabolism of nitrogen. Plant nutrition. Mineral constituents in metabolism. History of mycology. Plant pathology. Significant names in the history of botany.

REED's "Short History" is more than a dry record of progress. Through the kind and appreciative eyes of one of America's best-liked botanists the kaleidoscopic change in scenes and actors on the stage of botanical progress becomes a vivid adventure. This book will be enjoyed not only by professional botanists but also by students and others . . . This book is thoroughly original, in scope and treatment as well as in illustrations. We do not find the traditional portraits of the paragons of science which often are of questionable authenticity and usually are entirely non-committal as to the character of the subject. Instead, original illustrations of significant experiments, laboratories or publications are depicted, with delightful originality. One of the special values of the book is the adequate, though not undue, stress laid on the contributions of American scientists. The reviewer was surprised to find how seldom he disagreed with the author, which can only be attributed to the care with which Dr. REED has considered each contribution and the sympathy with which he has treated each contributor. It is easier to criticize mistakes than to appreciate positive advances, which become incorporated in our general body of knowledge and which can be recognized as advances only after careful consideration (WENT *in* SCIENCE).

► **THE ROYAL BOTANICAL EXPEDITION TO NEW SPAIN, 1787-1820** *by* **H. W. Rickett,** Ph.D. (New York Botanical Garden). — New light is shed on the explorations of SESSÉ and MOCIÑO and their colleagues by documents preserved in the National Archives of Mexico. A large number of letters, bills, receipts, itemized accounts, royal and viceregal orders are here collated so as to yield a connected story of the well known scientific expedition which investigated the natural productions of Mexico and neighboring lands, and established a botanical garden in the capital, from 1787 to 1820. Personal characteristics of the members of the expedition emerge clearly. — *Chronica Botanica, Vol. 11, No. 1;* Sup. roy. oct., ca. 80 pp., illustrated, *in press, ready late spring 1947* ....*ca.* **$2.50**

Contents: Introductory note. SESSÉ: Establishment of the Royal Botanical Garden. MOCIÑO: Exploration of Mexico. SESSÉ: The West Indies. LONGINOS MARTÍNEZ: Mutiny in the Expedition. CERVANTES: The Botanical Garden and the teaching of botany. SESSÉ and MOCIÑO: Return to Spain.

► **ESQUISSE DE MES VOYAGES AU BRÉSIL ET PARAGUAY, CONSIDÉRÉS PRINCIPALEMENT SOUS LE RAPPORT DE LA BOTANIQUE** *par* **Auguste de Saint-Hilaire** (1824), *with an introductory essay by* **Anna E. Jenkins,** Ph.D. — *Chronica Botanica, Vol. 10, No. 1 (1946)*; Sup. roy. oct., 62 pp., illustrated..................**$2.00**

This extensive travel account, reprinted from SAINT-HILAIRE's *Histoire des Plantes les plus remarquables du Brésil et du Paraguay,* has been reprinted primarily at the request of a number of S. American botanists. Though in the first place of interest to botanists (the author gives an accurate description of his route) it contains much of a general biological, geographical and historical interest.

► **PLANTS AND VITAMINS** *by* **Dr. W. H. Schopfer** (Univ. of Berne), *authorized translation from the author's unpublished French-Swiss manuscript by* **Norbert L. Noecker** (U. of Notre Dame). *Foreword by* **W. J. Robbins.** — A critical review of the vitamin problem, written from the viewpoint of general physiology, transecting the various fields of biology; microbiology, plant and animal physiology, biochemistry, morphology, cytology, genetics, medicine, plant pathology, horticulture, and agriculture. The practical applications of vitamin research are given special consideration. The theoretical aspects are also treated and should be of interest to students and teachers of general biology. — Revised photolithoprint ed. of the 1943 ed. (New Series Pl. Sci. Bks., Vol. 11), *Pallas, Vol. 1;* Sup. roy. oct., paper, 300 pp., 20 illustr. **$4.00**

Contents: The plant cell and its capacity for synthesis. The experimental study of growth factors and the selection of test plants. Classification, terminology, and definition of active substances. The principal vitamins synthesized by plants. Their action on plants synthesizing them. The biosynthesis of vitamins. Thiamin. Yeast and bios. Nicotinic acid, its amide, and other analogues. Staphylococcus aureus. Riboflavin, pyridoxine, and their analogues. The lactic bacteria. The nitrogen fixing bacteria. The hemophilic organisms and their group of growth factors. Individual factors: Ascorbic acid, cholesterol and vitamin D, pimelic acid, the SH-Group. The function of growth factors of vitamin nature. The vitamins as coenzymes. The vitamins in relation with other active substances. General consideration concerning the presence and the loss of the capacity for synthesis. Vitamins in nature. Their rôle in agronomy and horticulture. Vitamin cycles. Growth factors and sexuality. Symbiosis, parasitism, and vitamins. Microorganisms as biological test objects for vitamins.

It is that rare thing: a complete textbook. Apparently everything relevant has been included, and the matter is right up to date as far as it is possible for it to be. 'Plants and Vitamins' gives the conspectus of a new subject — the need of plants for vitamins (NICOL *in* SOILS AND FERTILIZERS).

► **PLANTS AND PLANT SCIENCE IN LATIN AMERICA,** *edited by* **Frans Verdoorn,** Ph.D. — The aim of this collection of concise accounts of practically all aspects of agriculture, botany, ecology, forestry, plant pathology, plant breeding, etc., in the countries of Central and South America, prepared by nearly a hundred international authorities, is to give the agronomist, botanist, forester and phytopathologist, wherever he may be located, information which he may need when starting work on the wild or cultivated plants of Latin America. It is hoped that it may be still more useful for those who plan to go to Latin America to collect or to conduct research. The collection endeavours to give some information concerning the present status of and the future possibilities and needs for research in the chief branches of the pure and applied plant sciences in Latin America. In addition to data in his own field, the specialist will find much useful and stimulating information on vegetational and agronomic problems in general, on the organization of research, lists of books that he may consult, addresses of institutions and societies in the territory in which he is interested and which he may profitably contact, etc. — Special features are the plates, often reproduced from classical publications, and the extensive introductory chapters by POPENOE, JOHNSTON and SMITH, FOSBERG, and PENNELL. — A minor part of this volume has previously been published in CHRONICA BOTANICA and is now again presented after careful revision. Much more than half consists of original contributions, not published before, by outstanding international authorities. — *A New Series of Pl. Sci. Bks., Vol. 16 (1945)*; Sup. roy. oct., buckram, xl + 384 double column pp., 83 pl. and text illustr. $6.00

The book is comprehensive and at the same time presents much detail. More than one-half of the 89 chapters deal with problems or situations of interest to individual countries and apparently every country is covered as to one or more phases of the subject, including Galapagos, Cocos, and Falkland Islands. Every phase of botanical interest gets some consideration. Floras, plant resources, and crops of special economic interest (oils and fats, fibers, rubber, quinine, etc.) get rather full consideration. Plant pathology, forestry, ecology, geology, meteorology, conservation, and soils are all handled in one or more chapters. The 89 chapters are written by a somewhat smaller number of well-known authorities in the general field of plant science; the greater number of these are from the United States, a large number from Latin America, with England and Sweden represented. The listing of plant science institutions, stations, societies, etc., occupies 13 pages; a detailed table of contents, 25 pages; the personal name index, 7 pages; and the description of 38 plates and of 49 text illustrations, one page each. Considering that the subject covered by this book would require many volumes for an exhausted presentation, one is surprised how much of the field is presented in easily available form in slightly more than 400 pages; this accomplishment is furthered by the two-column page format which conserves space, by good tabulation and indexing, and by the excellent selection of illustrations and maps. No institution or individual interested in plant science in Latin America can afford to be without this volume for frequent reference (WILLIAM CROCKER *in* CHEMICAL AND ENGINEERING NEWS).

Succeeded beyond the most sanguine hopes and expectations of his botanical colleagues . . . a commentary not only upon his own energy, enthusiasm and vision but also upon the proficiency and competence of the numerous collaborators, whom he chose to aid him in the task . . . will forever be deeply indebted to Dr. Verdoorn not only for his part in a monumental contribution to botany but also for the splendid example which he has set of scientific "good neighborliness". (MANGELSDORF *in* QUART. REV. OF BIOL.).

Those who are interested both in Latin America and biology or agriculture, have long been looking for a compilation like "Plants and Plant Science in Latin America". — It will prove invaluable to many types of research workers as well as to educators and practical men (HENRY A. WALLACE).

From the contents:—

— PART I —

— PART II —

► **MANUAL OF BRYOLOGY,** *edited by* **Frans Verdoorn,** Ph.D. — A coöperative manual dealing with all aspects of the general botany of mosses and hepatics, as well as with the principles of bryological taxonomy and phylogeny. — *Published in coöperation with Messrs. Nijhoff, the Hague (1932)*; Roy. oct., cloth, 485 pp., 129 plates and illustr.......**$12.00**

Contents: van der Wijk: **Morphologie und Anatomie der Musci;** *Buch:* **Morphologie und Anatomie der Hepaticae;** *Buch:* **Experimentelle Morphologie;** *Chalaud:* **Germination des spores et phase protonémique;** *Nicolas:* **Association des Bryophytes avec d'autres organismes;** *Motte:* **Cytologie;** *Hoefer:* **Karyologie;** *Garjeanne:* **Physiology;** *von Wettstein:* **Genetik;** *Herzog:* **Geographie;** *Gams:* **Quaternary distribution;** *Gams:* **Bryo-Cenology (Moss-Societies);** *Richards:* **Ecology;** *Dixon:* **Classification of Mosses;** *Verdoorn:* **Classification of Hepatics;** *Zimmermann:* **Phylogenie.**

► **MANUAL OF PTERIDOLOGY,** *edited by* **Frans Verdoorn,** Ph.D. — A coöperative manual dealing with all aspects of the general botany of ferns and fern allies, as well as with the principles of pteridological taxonomy and phylogeny. — *Published in coöperation with Messrs. Nijhoff, the Hague (1938)*; Roy. oct., cloth, 640 pp., 121 plates and illustr...**$14.00**

Contents: Schoute: **Morphology and anatomy;** *Williams:* **Experimental morphology;** *Gregor:* **Association with fungi and other lower plants;** *Burgeff:* **Mycorhiza;** *Docters van Leeuwen:* **Zoocecidia;** *Atkinson:* **Cytology;** *Döpp:* **Karyologie;** *Andersson-Kottö:* **Genetics;** *du Buy and Nuernbergk:* **Growth, tropisms and other movements;** *Wetzel:* **Chemie und Stoffwechsel;** *Gams:* **Oekologie der extratropischen Pteridophyten;** *Holttum:* **The ecology of tropical pteridophytes;** *Winkler:* **Geographie;** *Hirmer:* **Geographie und zeitliche Verbreitung der fossilen Pteridophyten;** *Kräusel:* **Psilophytinae;** *Walton and Alston:* **Lycopodiinae;** *Hirmer:* **Psilotinae und Articulatae;** *Christensen:* **Filicinae;** *Hirmer:* **Fossile Filicinae und Pteridophyta incertae sedis;** *Zimmermann:* **Phylogenie.**

► **VERNALIZATION AND PHOTOPERIODISM — A SYMPOSIUM** *by* **R. O. Whyte,** Ph.D. (Aberystwyth), **A. E. Murneek,** Ph.D. (Columbia, Mo.) *and others. Foreword by* **K. V. Thimann,** Ph.D. (Harvard). — A cooperative account of the history, recent developments and certain special aspects of research in vernalization and photoperiodism in plants. — *A New Series of Pl. Sci. Bks., Vol. 21;* Sup. roy. oct., ca. 180 pp., many illustrations and portraits, *in press, ready summer 1947. ..ca.* **$4.75**

From the contents: K. V. Thimann: **Introduction.**
R. O. Whyte: **History of research on vernalization.**
A. E. Murneek: **History of research on photoperiodism.**
H. A. Allard: **Length of day in the climates of past geological eras and its possible effects upon changes in plant life.**
G. L. Funke: **The photoperiodicity of flowering under short day with supplemental light of different wave lengths.**
K. C. Hamner: **Hormones in relation to vernalization and photoperiodism.**
A. E. Murneek: **Nutrition and metabolism as related to photoperiodism.**
M. Parker, H. Borthwick, and S. B. Hendricks: **Wave length, dependence and the nature of photoperiodism.**
R. H. Roberts and B. Esther Struckmeyer: **Anatomical and histological changes in relation to vernalization and photoperiodism.**
S. M. Sircar: **Vernalization and photoperiodism in the tropics.**
F. W. Went: **Thermoperiodicity.**

► **FOREST SOILS AND FOREST GROWTH** *by* **S. A. Wilde,** D.T.Sc. (Univ. of Wisconsin). — Soils support forests as they do crops. The composition of forests, their rate of growth, the quality of wood they produce, the ease with which they reproduce themselves, their effectiveness in watershed protection, are all influenced to a greater or less extent by the soils they occupy. Management of forests must take into account not only the trees themselves but also the soil. An understanding of the soil is therefor essential to the forester. — This book is the first work in English dealing specifically with forest soils. It is written by one who is both forester and soil scientist. Because of this dual background, the book has more than ordinary meaning for both foresters and soils men as the writer in preparing his text has correlated the work in both fields. He has brought to bear upon American silviculture and forest problems, not only his specialized training, but also a background of knowledge obtained in the primeval forests of north Europe and Siberia and in the intensively managed forests of central Europe. The treatise brings out the correlation between life of the forest and the genesis, physics, chemistry, and biology of the soil. It gives consideration to all phases of tree growth from seedlings in the nursery, to second growth and mature stands. It discusses the relation of soil to plantations, and the farmers' woodlots as well as to extensive forest areas. — The book is based upon the writer's lectures at the University of Wisconsin to upper classmen and graduate students in soils, forestry, wildlife management and related subjects. Because of the rather unconventional type of treatment of the subject matter, and the great amount of illustrative material drawn from the author's research and experience, the material should be of wide interest to a large circle of specialists not only in silviculture but also in such fields as farm management, nursery men, soil conservationists, ecologists, game managers, and landscape architects. The bibliography of several hundred references, international in scope, adds greatly to the value of the book. — *A New Series of Pl..Sci. Bks., Vol. 18 (1946)*; Sup. roy. oct., buckram, 242 pp., illustrated..............................**$5.00**

Contents: Historical and introductory. Genesis of forest soils. Genetic soil groups of the world; upland soils. Genetic soil groups of the world; hydromorphic and embryonic soils. Forest cover; its biological structure and its relation to environment. Physical properties of forest soils. Chemical properties of forest soils. Organisms of forest soils. Forest humus. Soil-forest types. Forest soil survey. Soils and tree planting. Amelioration of forest soils. Silvicultural cuttings in relation to soils. Productivity of forest soil and forest management. Establishment of forest nurseries and control of nursery watering. Use of commercial fertilizers and lime in forest nurseries. Use of composts, liquid fertilizers, and green manure crops in forest nurseries. Adjustment of nursery soil fertility. Control of parasitic organisms in soils of forest nurseries. References. Author index. Subject index. Plates.

► **HAYFEVER PLANTS, THEIR APPEARANCE, DISTRIBUTION, TIME OF FLOWERING AND THEIR ROLE IN HAYFEVER** *by* **Roger P. Wodehouse,** Ph.D. (Lederle Laboratories). — This book brings together very nearly all of the botany that it is desirable to know in order to gain a clear understanding of the rôle that plants and their pollen play as causes of the allergies, hayfever and asthma. It could as well be called the *Botany of Hayfever* or the *Botany of Allergy,* though it is not intended to reach much beyond the botanical aspects of hayfever and asthma. — The book was written largely in response to questions that have come to the author from members of the medical profession, from plant scientists and from sufferers of hayfever. — *A New Series of Pl. Sci. Bks., Vol. 15 (1945)*; Sup. roy. oct., buckram, 245 pp., 73 illustr......**$5.00**

Contents: **The botany of hayfever (The flower. What makes some plants cause hayfever? Hayfever toxicity. Atmospheric pollen. Identification. Preparation of pollen slides. Botanical literature. Cultivated plants. The trees. Monographs of restricted groups). The hayfever plants: Gymnosperms. The hayfever plants: Angiosperms. Regional surveys (The northeastern states. The middle atlantic states. The Virginias and Carolinas. The north-central states. The southern states. The southwest. Southern California. The north pacific states. The Rocky Mountain states. Plains and prairies). Glossary. Bibliography. Author Index. General Index.**

The publication of WODEHOUSE is a splendid compilation of botanical information that is essential to all students of allergic disease. In Chapter I, the author discusses the botany of hayfever and gives detailed instructions for the collection and identification of pollen in the atmosphere. He also reviews the publications of the regional botanical flora of the United States. In Chapters II and III, he presents a detailed description of each plant which enters into the etiology of pollen hayfever. The Gymnosperms comprise those trees which bear cones and carry the pollen in small anther sacs located on the under surface of scales of the smaller cones. The junipers, the pines, the spruce, the cedars, the hemlocks, the firs and the cypress comprise this group. The Angiosperms are distinguished by their universal habit of producing true flowers with pollen deposited on the stigma. There are countless species in this group: many trees, all grasses, and the large compositae species including the common plant, ragweed. In Chapter IV, the author compiles the reports of pollen surveys which have been made by investigators in all sections of the United States. References which can be used for the comparison of one season with another in the same state or group of states are cited. Throughout this comprehensive treatise the author writes in a most enjoyable manner. His original illustrations have an individual style that is pleasing as well as informative. Of great value are the author's pen drawings of the various plants and of the highly magnified pollen grains. These should make identification easy, even to the inexperienced student. The material in this publication is of great value to the scientific world (L. N. G. *in* BULLETIN OF THE JOHNS HOPKINS HOSPITAL).

The PUBLISHERS' WEEKLY *discussing* "HAYFEVER PLANTS," *selected as one of the best four books and the best textbook, published during June 1945, by the Trade Book Clinic of the American Institute of Graphic Arts, declares: [This] "is an excellent example of how, with good typographical knowledge and great skill, a scholarly text embodying such difficult features as tables, figure columns, footnotes, glossary, and bibliography, can be made into a handsome almost elegant book. Verdoorn successfully solved many knotty problems in the design of this volume, and it is unfortunate that space will not allow a more detailed discussion of the points involved. The many line cuts of plants beautifully combined with the text have produced a perfectly balanced page. The type pages, though at times by necessity quite condensed, are always clean and readable. Chapter titles and section titles contrast well with the old style used for the text. Nothing has been left undone to increase the consultability of the material and yet no space has been wasted. The end paper in French blue nicely matches the dark blue buckram of the binding, the Bordeaux red top stain and head band add to the appearance of this handsome volume."*

► AN INTRODUCTION TO HISTORICAL PLANT GEOGRAPHY *by* Dr. **E. V. Wulff** (Leningrad), *authorized translation by* **Elisabeth Brissenden.** *Foreword by* **Elmer D. Merrill.** — An original and authoritative account of the general and theoretical problems of historical plant geography, based on the author's famous Russian handbook, revised and brought up-to-date. This American edition has been prepared at the request of botanists from many parts of the world, as there exists not a similar modern book in English, German or French. — *A New Series of Pl. Sci. Bks., Vol. 10 (1943)*; Sup. roy. oct., 223 pp., 35 illustr. **$5.00**

The last few years have furnished to the phytogeographer such valuable new tools and so much fresh evidence, that a phase of expansion of the subject clearly lies ahead. Of this our botanical students are vaguely or not at all aware, and this first English text to reveal the new potentialities must therefore be valuable and welcome. — We can best convey the content of the book by the chapter headings: (1) historical plant geography: scope, relation to allied sciences, methods of investigation; (2) history of the science; (3) areas, their centres and boundaries; (4) the origin of areas; (5) types of areas; (6) parallelism in the geographical distribution of plants and animals and correlation between the distribution of parasites and that of their host plants; (7) artificial factors in the geographical distribution of plants; (8) natural factors in the geographical distribution of plants; (9) the migrations of species and floras and their causes; (10) historical causes for the present structure of areas and the composition of floras; (11) concept of floral elements (GODWIN *in* NATURE).

In spite of the war, and that means much more in Russia than in America, it has been possible to arrange for Miss BRISSENDEN to work in close association with Dr. WULFF in Leningrad and then to publish the completed manuscript in this country. Once more science surmounts international boundaries and the catastrophes of war. As Dr. MERRILL states this volume "is a mine of logically and authoritatively discussed information on the subject." The book will be of special value to plant geographers, because it analyzes a large amount of continental, especially Russian, literature not otherwise readily available (MATHER *in* AMERICAN SCIENTIST).

► MARINE MICROBIOLOGY *by* **Claude E. ZoBell**, Ph.D. (Scripps Inst. of Oceanography). *Foreword by* **S. A. Waksman.** — A monograph on hydrobacteriology with special reference to the distribution, characteristics, and activities of bacteria and allied microorganisms in oceans, seas, and lakes. Written from an ecological point of view with emphasis upon the effect of bacteria upon the marine environment and the effect of environmental conditions upon the distribution of microorganisms. — *A New Series of Pl. Sci. Bks., Vol. 17 (1946)*; Sup. roy. oct., buckram, 240 pp., 12 illustr., numerous tables **$5.00**

Contents: General introduction. The marine environment. Collection and examination of samples at sea. Methods of enumerating marine bacteria. Factors influencing the distribution of bacteria in the sea. Microorganisms in bottom deposits. Activities of microorganisms in bottom deposits. Characteristics of marine bacteria. Aquatic yeasts and molds. Transformation of organic matter. The nitrogen cycle in the sea. Bacteria which transform sulfur compounds. The phosphorus cycle. Relation of marine bacteria to flora and fauna. Microorganisms in marine air. Sanitary aspects of marine microbiology. Economic importance of marine microorganisms. Microbiology of inland waters. Bibliography.

Though written largely as a summary of the literature with few synthetic paragraphs, the peculiar nature and importance of the bacteriology of the ocean is easily grasped from a study of this book. Bacteria, though of immense importance in the ocean, do not find in it an ideal habitat. Much of the bacterial flora is concentrated in the upper part of the sediments, or on the surfaces of suspended or sedimenting solid bodies. The open ocean is too low in inorganic compounds to permit vigorous development of a bacterial flora save where absorption on solid particles concentrates the organic matter. An antibiotic material is, moreover, rather widespread in natural sea water, though the nature of this substance, which may be of great importance in marine biology, is not adequately understood. The specificity of the marine flora is such that marine bacteria can easily be identified in air masses moving onto land from the surface of the ocean. The geologist will find ZOBELL'S discussion of the lower limit of the biosphere of peculiar interest. Bacteria can be recovered in small numbers from the lower parts of the longest deep sea cores yet taken. The habitat of these bacteria is sediment formed at a quite remote time, in some cases probably during the Pleistocene. There is evidently here a wide and relatively unexplored field of study. ZOBELL tentatively suggests that rising earth temperature with increasing depth puts a limit on the survival of bacteria buried in marine sediments. *Marine Microbiology* should be carefully studied by everyone interested in any of the many aspects of science on which its subject matter impinges. The book is attractively produced and very well indexed (HUTCHINSON *in* AMERICAN JOURNAL OF SCIENCE).

Dr. ZOBELL has succeeded in collating numerous investigations and presenting the essential information in a most readable, well-planned and inclusive treatise. In the words of Dr. WAKSMAN, who has written a foreword to the volume, he "has rendered a distinct service to the bacteriologist, to the oceanographer and to all those who are interested in the cycle of life in natural water basins." Well written, suggestive of many intriguing problems awaiting investigation, this book will surely give further impetus to the study, not only of bacteria, but also of all the small creatures in the sea (HARVEY *in* NATURE).

CHRONICA BOTANICA CO.

Book Department

Waltham, Massachusetts, U.S.A.

LIST 2. — **Recent Biological and Agricultural Books, chiefly published in North America, including some older Standard Reference Works.**

Orders for material from this list should be sent directly to the Chronica Botanica Co. — Prices are net. We pay postage on orders accompanied by a remittance in full. — All prices subject to change without notice. — We do not solicit and cannot fill orders for material not included in our catalogue and printed lists.

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1. Abderhalden, E. (*ed.*), 1911/33: **Biochemisches Handlexikon**, 15 vols. (U.S. repr.), postage extra $285.00
2. Abrams, Leroy, 1940: **Illustr. Flora of the Pacific States**, Vol. 1, 538 p. $7.50
3. Abrams, Leroy, 1944: **Illustr. Flora of the Pacific States**, Vol. 2, 635 p. $7.50
4. Anson, M. L., & J. T. Esdall, 1944: **Advances in Protein Chemistry**, Vol. 1, 341 p. $5.50
5. Bailey, 1945: **Industrial Oil and Fat Products**, 746 p. $10.00
6. Bailey, L. H., 1928: **Standard Cyclopedia of Horticulture**, 3 vols., postage extra $25.00
7. Bailey, L. H., 1941: **Hortus Second**, 778 p. $5.00
8. Bamann, E., & K. Myrbäck, 1945: **Die Methoden der Fermentforschung**, 4 vols., 3388 p., postage extra $65.00
9. Bates, R. S., 1945: **Scientific Societies in the United States**, 246 p. $3.50
10. Baxter, 1943: **Pathology in Forest Practice**, 627 p. $5.50
11. Bennett, H. (*ed.*), 1944: **Commercial Waxes, Natural and Synthetic**, 583 p. $11.00
12. Berry, F. A., *et al.* (*eds.*), 1945: **Handbook of Meteorology**, 1077 p. $7.50
13. Block, R. J., & D. Bolling, 1944: **The Amino Acid Composition of Proteins and Foods**, 396 p. $6.50
14. Bloor, W. R., 1943: **Biochemistry of the Fatty Acids and their Compounds**, 387 p. $7.00
15. Blume, C. L., 1823: **Catalogus van . . . Gewassen, . . . in's Lands Plantentuin te Buitenzorg**, Lithopr. reprod. 1945, 112 p. $2.00
16. Borkman, S., J. C. Morrell, & G. Egloff, 1940: **Catalysis, Inorganic and Organic**, 1130 p. $20.00
17. Boström, S. (*ed.*), 1940: **Kautschuk und verwandte Stoffe**, 534 p. $20.00
18. Brody, S., 1945: **Bioenergetics and Growth**, 1023 p. $10.00
19. Brown, H. P., & A. J. Panshin, 1940: **Commercial Timbers of the United States**, 554 p. $5.00
20. Cain, 1944: **Foundations of Plant Geography**, 556 p. $5.00
21. Campbell, 1940: **Evolution of Land Plants**, 731 p. $6.50
22. Chaney, R. W., C. Condit, & D. I. Axelrod, 1944: **Pliocene Floras of California and Oregon**, 407 p. (cloth) $5.00
23. Chester, K. S., 1945: **Nature and Prevention of Plant Diseases**, 584 p. $4.50
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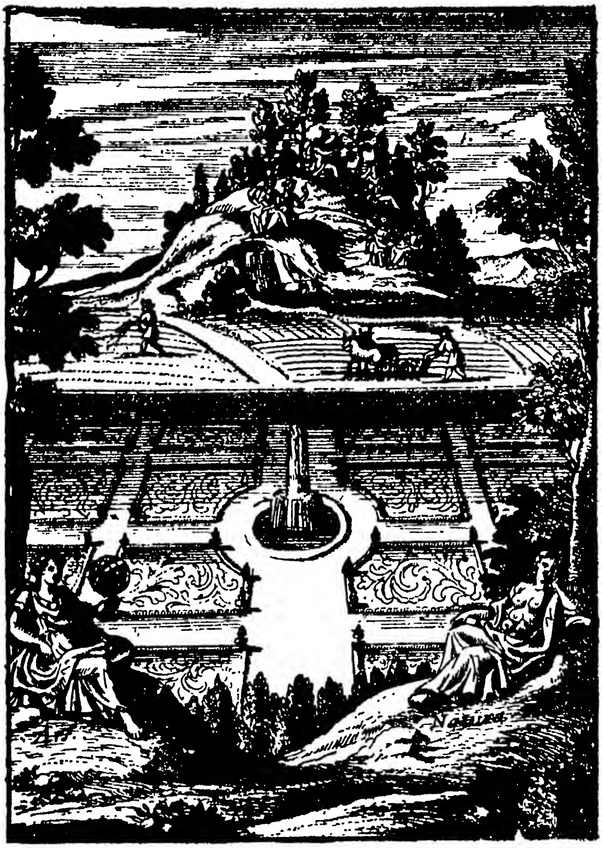

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